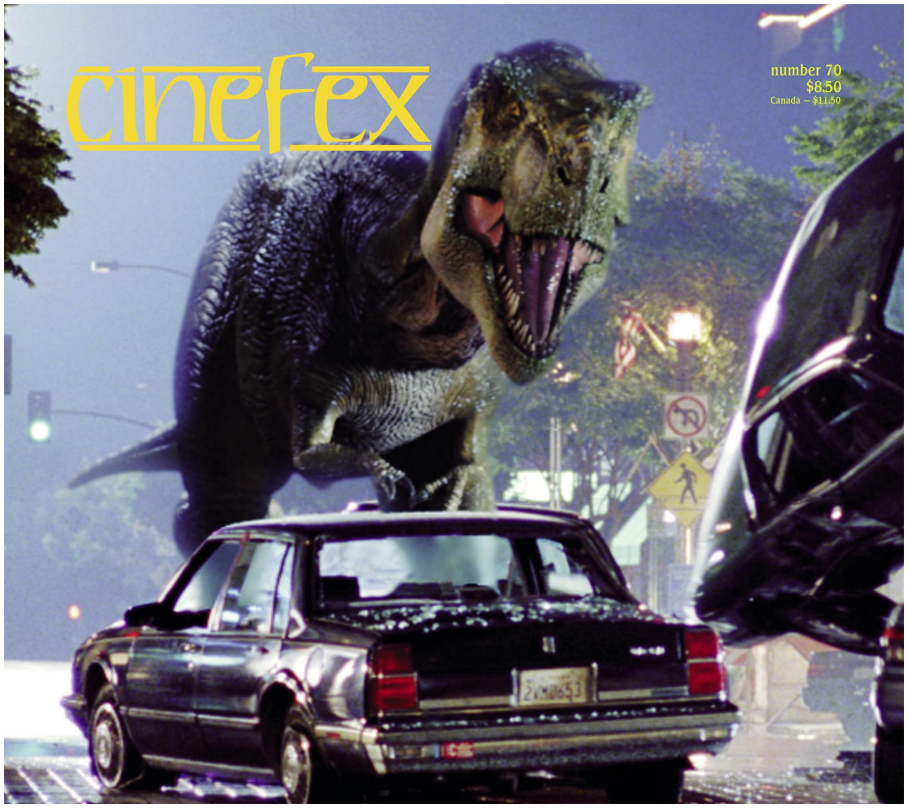
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Basic Black 15

For director Barry Sonnenfeld's science fiction comedy *Men in Black* – about shadowy government agents who oversee extraterrestrial activities on earth – makeup effects artist Rick Baker produced a variety of imaginatively conceived aliens, supplemented by computer generated creations and other effects concocted by Industrial Light & Magic. *Article by Janine Pourroy.*

On the Shoulders of Giants 72

When it came time to select an effects team for *The Lost World*, director Steven Spielberg turned promptly to character creator Stan Winston, visual effects supervisor Dennis Muren of Industrial Light & Magic, and special effects supervisor Michael Lantieri – the trio that had written effects history on *Jurassic Park* – to once again push the boundaries of artistry and technology. *Article by Jody Duncan.*

Elemental Images 114

To impart an epic quality to *The Fifth Element* – his whimsical science fiction adventure about a New York cab driver who is called upon to help save the universe from annihilation – director Luc Besson turned to Digital Domain and visual effects supervisor Mark Stetson to create an array of futuristic cityscapes and distant worlds through a blend of traditional and digital imagery. *Article by Ted Elrick.*

Con Air: Skyjinks 49

Anaconda: Snake Charmers 61

Classic Restoration: The Lost World – Found! 143

COVER – A prehistoric parent pays a visit to San Diego in *The Lost World.*

BASIC BLACK

ARTICLE BY JANINE POURROY

An illegal alien • disguised as an undocumented immigrant • was one of many extraterrestrials created by Rick Baker and his Cinovation Studio for the Barry Sonnenfeld sci-fi comedy Men in Black.

It makes perfect sense when you think about it. That otherworldly third grade teacher with the cat's eye glasses; the lonely laundromat patron who watches the towels go round at three in the mornings; the stranger you pass on the street who seems to be from Mars. And all that unsettling speculation about extraterrestrial visitation, with no substantiating evidence beyond half-remembered dreams. Perhaps aliens really do walk the planet.

Producers Walter F. Parkes and Laurie MacDonald certainly felt the notion was worth pursuing when they optioned the graphic novel, The Men in Black, in 1992. Based on an obscure comic book series, the original story grew from an urban legend maintaining that individuals who have encounters with aliens are soon visited by mysterious men — dressed in black — whose job it is to cover up the incident. It posited that there are 1500 or so aliens living among us — and that no alien with decent intentions would want to live on earth. Therefore, such visitors would need to be policed by an archetypal force of very cool, fifties-style G-men.

Parkes and MacDonald were drawn to the pro-ject by several significant story elements. First of all, it featured powerful American archetypes as protagonists. They liked the human approach to the science fiction — and knew that strong actors would be attracted to the well-drawn roles. They also appreciated its reality-based setting, as opposed to the interdimensional or interplanetary trappings more typically employed by the genre. Aware that they would need considerable clout to move the project forward, Parkes and MacDonald took Men in Black to Amblin Entertainment where Steven Spielberg agreed to lend his support as executive producer. The producers then approached director Barry Sonnenfeld, who read the Ed Solomon screenplay and was immediately engaged by the unusual premise.

Cinovation artist Aaron Sims paints a maquette of the character.

Baker and his crew outfit actor John Alexander on the set.

With Sonnenfeld firmly at the helm and with backing from Columbia Pictures Men in Black entered preproduction in the spring of 1995. Sonnenfeld collaborator Don Peterman, who had photographed the director's Addams Family Values and Get Shorty, was brought on board as cinematographer, and production designer Bo Welch set about establishing the 1960s World of Tomorrow retro look that would ultimately frame the movie. Under the direction of visual effects supervisor Eric Brevig, Industrial Light & Magic was engaged to craft more than two hundred effects shots, and special makeup effects artist Rick Baker was enlisted to create the film's intergalactic ensemble. On-set special effects would be handled by vet- eran physical effects supervisor Peter Chesney.

A flying saucer a CG effect by Industrial Light and Magic blazes across the sky and crash-lands on a farm.

Its occupant kills the farmer, Edgar (Vincent D&#xFFFD;Onofrio), and dons his skin as a disguise. The skin decomposes during the film through a series of Rick Baker makeups.

Preproduction meetings commenced at ILM in September 1995; and by November, Brevig [illegible] with visual effects producer Jacqui Lopez [illegible] had assembled a small crew to begin planning the show and fleshing Sonnenfeld[illegible]s general ideas into solid designs. Along with numerous logistical decisions, establishing the appropriate tone for the film was one of the first considerations the visual effects team had to face. [illegible]The script had a lot of dark comedy, so we knew going into it that it had to have a humorous tone,[illegible] stated Brevig, [illegible]but it was really a matter of finding the right balance. We had to make sure the tone was serious enough so that the science fiction audience wouldn[illegible]t see it as one big joke [illegible] while at the same time, not making it so dark and cold that it became a hardware movie.[illegible]

The alien Edgar tightens his loose-fitting skin.

Creating an array of unique, never-before-seen aliens was another early priority, and Rick Baker immediately began turning out masses of drawings from his Cinovation Studio. [illegible]I think we did more designs for this one film than all the designs I[illegible]ve done for every film in my life,[illegible] Baker commented. [illegible]Several artists had been involved with the project a full year before I was hired; but even at that point, nothing seemed to be in the ballpark. I looked at their designs, and said to Barry and Steven, [illegible]Just say if there is anything here that[illegible]s close to what you have in mind.[illegible] There was a pretty good range of looks and we needed a place to start [illegible] but they weren[illegible]t ready to make any decisions at that point. I didn[illegible]t want to waste time, so I said, [illegible]All right, we[illegible]ll start doing drawings of our own.[illegible][illegible] The Cinovation team focused in particular on Mikey, an alien featured during the film[illegible]s pivotal opening sequence.

The story begins with several agents from the U.S. Immigration and Naturalization Service stopping a van filled with illegal aliens at the border. As the agents are lining up a dozen frightened Mexican nationals, a black 1986 Ford LTD screeches to a halt and two men, dressed in plain black suits, emerge from the car. They are Agent Kay (Tommy Lee Jones) and his partner Agent Dee (Richard Hamilton) who, as they inform the INS men, are with Division 6 and are there to take charge. Agent Kay pulls a poncho-wearing suspect named Sergio out of the lineup and begins to interrogate him. His suspicions confirmed, Kay slits open the poncho and orders Sergio to hand him his head and put up his arms. Sergio complies [illegible] holding his articulated human head like a puppet on a stick [illegible] and reveals himself as Mikey, a giant, blue-skinned desperado on the lam for no less than seven intergalactic treaty violations.

The script had originally described Mikey as a scaly, four-and-a-half foot tentacled creature with eye stalks on the top of his head, yet Baker knew virtually any concept was possible and explored a variety of approaches to the alien's appearance. After an exhaustive design period, Baker finally handed Sonnenfeld a drawing the director could approve. Mikey had grown considerably, and now featured flippers, antennae and a completely renovated physique. Yet despite the ambitious design, his anatomy was reasonably straightforward. "An entirely mechanical creature is incredibly difficult and time consuming to build," noted Baker. "It is also somewhat limiting. So I suggested we alter the design slightly and put a person in it. Barry agreed. The only actor I knew capable of wearing a suit like Mikey was John Alexander, who I had worked with on Gorillas in the Mist and Greystoke. John is an amazing performer and a really nice guy. You can torture him and he doesn't complain."

Men in Black Headquarters, a haven for visiting extraterrestrials, featured a multitude of aliens. Cinovation crew member Aaron Sims and head puppeteer Tony Urbano rehearse four animatronic aliens on a coffee break.

Other effects firms were enlisted to help populate the busy headquarters. An alien father and son were supplied by ME*FX.

An elaborate desert set was built on stage at Sony Pictures Studios, where principal photography commenced in March 1996. Uncertain of the live-action staging demands, Baker and team leader Matt Rose wanted the special makeup to be capable of whatever maneuvers might be necessary to bring Mikey to life. "Because the eyes were on stalks, I thought it would be interesting to do an unusual eye blink," stated Baker. "It was basically like a foreskin. The skin would slip around the eye to close and then stretch back to open. The cable-operated head was also capable of complete facial and mouth movement." Two additional heads were also devised for Mikey, including a radio-controlled one with modified functions and a nonarticulated stunt head to be worn whenever Alexander needed to run. Mechanics designer Jurgen Heimann built articulation into the body, as well. The suit featured radio-controlled flippers that jutted out from the torso, with antennae emerging from the ear. Three-fingered arm extensions were cable-rigged to provide the character with

dexterous movement, while simpler, poseable arms were exchanged whenever longer camera shots permitted. Two-and-a-half-foot leg extensions elevated Mikey to seven feet.

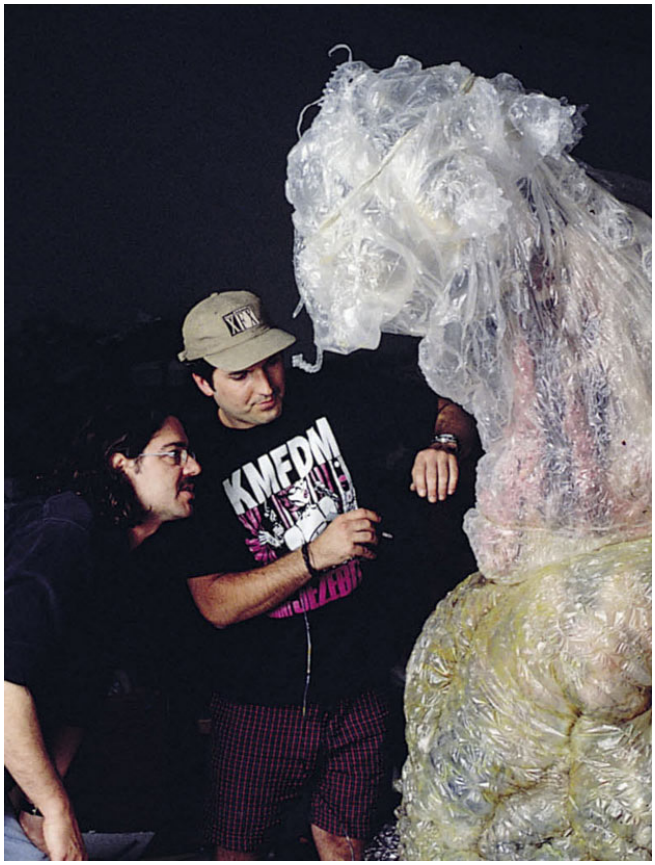
Two Sergio heads were also built, a stunt head with no internal mechanism and a fully articulated, self-contained, radio-controlled head operated off camera by two puppeteers. "It was a very realistic head," stated Baker. "The eyes moved up and down and back and forth, and it had a really cool blink. The jaw also moved completely around. During the shoot, we puppeteered Sergio's mouth to move while Mikey was doing the talking " which looked really great."

XFX contributed a suit-based alien with major head articulation.

Scripted action requiring Mikey to turn tail and dart into the desert night proved problematic on several fronts. Baker was worried about having Alexander run in stilts across the uneven terrain of the set especially since the actor was virtually blind within the head piece. Additionally, Sonnenfeld wanted Mikey to run a considerable distance into the desert, which was a physical impossibility within the confines of the stage. In terms of both safety and logistics, the reasonable solution was to have the character transform from the Cinovation creature into an ILM computer graphic image.

Baker had been aware that Mikey would segue from live-action creature into a computer generated likeness, and sent the designs and a maquette of the character to ILM early on. There a computer generated model was built by George Aleco-Sima, using Alias software, and then animated under the supervision of Rob Coleman. Concurrent with those efforts, view painter Jean Bolte began devising the paint scheme that would embellish Mikey's final appearance. "Mikey transitions from Rick's makeup to computer graphics imaging with the "roar shot,"" said Coleman, "which is where he transforms from a very meek character into a ferocious monster. He was a great model to animate because he was so distinctive looking. I worked on him in the beginning, and was later joined by Glenn Sylvester and Tim Harrington, who did a great job on the transformation. They animated these huge jaws opening to reveal teeth and a big purple tongue as well as eyes that bug out. We used the Caricature or Cari animation software that Cary Phillips designed for Dragonheart. It proved very valuable in creating Mikey's muscles and skin transformations."

Softimage was used to articulate the creature. "Animating Mikey was a bit like doing Fred Flintstone running through his house," said Coleman. "You know how you keep seeing that

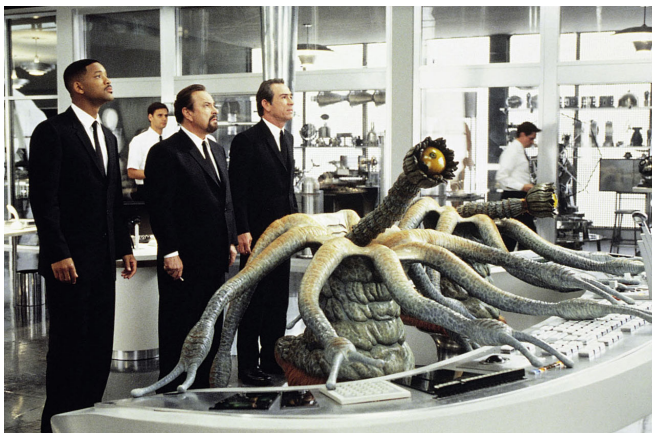


Steve Johnson and Mark Killingsworth of XFXpaint an amorphous alien made of plastic bags.

Tim Ralston and Howard Berger of KNBEFX test radio-controlled aliens designed to scuttle across the floor.xs

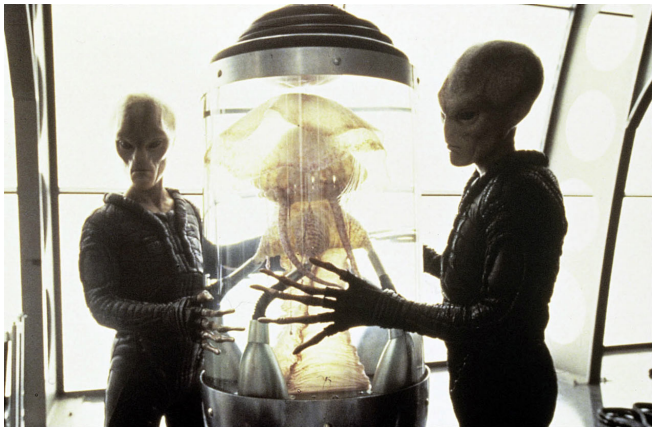
same vase go by? That was because the stage area at Sony was actually pretty short, and Mikey had to appear to be running and running. We treated it almost like a loop. The hard part was making him look heavy. Animating weight in the computer is difficult because weight does not exist there. The impression of weight is perceived by the human eye according to what's happening to the body parts: how much follow through is in an arm, how much jiggle is in the belly. So we added all kinds of controllers to get Mikey's skin going and his belly wiggling and the muscles in his legs flexing.' As reference for the rippling and overlapping actions of Mikey's muscle groups, Coleman studied videotapes of world class athletes in action. 'Also, because Mikey was supposed to be over 300 pounds, I watched a lot of NFL slow-motion films. They were valuable for observing heavy men running very quickly.'

Because of the complicated animatronic-to- CGI choreography, the scene had first been established as a computer graphics previsualization ' a tool that proved useful from principal photography through final rendering. 'Many times the director will shoot the plate first and we'll have to figure out how to add the CG elements after the fact,' stated CG supervisor John Berton. 'When that happens, we spend all of our time trying to figure out how to make something work instead of spending the time making it look good. One of the ways we can figure out how it'll work is through previsualization, which functions like a moving storyboard. The previz of Mikey running through the desert helped Barry set up his shots. He was able to use the CG as reference for the kind of camera angles he wanted to select. We could then animate back into those plates with a pretty good idea of what our creature was going to do, what his stride length was going to be, and how he was going to interact within the context of the setting.'



Agents Jay, Zed and Kay (Will Smith, Rip Torn and Tommy Lee Jones) view monitors operated by tentacled aliens built by KNBEFX.

Not long after our introduction to Mikey, the action shifts to New York City where police officer James Edwards (Will Smith) is in foot pursuit of a perpetrator running at very high speed through the city streets. Ultimately, this human-disguised alien leaps onto the roof of the Guggenheim Museum, shouts something about the world coming to an end then falls to his death.



Two Cinovation aliens flank a jellyfish alien made by XFX. Many of the creatures were last-minute additions to lend admosphere to the headquarters scenes.

When Agent Kay arrives at the morgue to cover up the incident, he meets Edwards, who is baffled by his close encounter with the bizarre being. Kay invites Edwards to accompany him in paying a call on pawnbroker Jack Jeebs (Tony Shalhoub), who is known to Edwards for dealing in stolen Rolexes, and to Kay for an item considerably more exotic alien weaponry. The scene takes a surprising turn when Kay, impatient with Jeebs evasiveness, unceremoniously shoots his head off and then watches it grow back in less than a minute. My initial design for Jeebs was this kind of crotchety, Popeye-looking pawnbroker with a cigarette dangling out of his mouth, recalled Baker. It would have been a really neat makeup, but Barry wanted something closer to the way Tony really looked. So I designed a more goofy-looking one, with a big nose and ears and this walleye, for which we used a contact lens painted off-center.

A cyberscan was created of Shalhoub in the Jeebs makeup and sent to ILM where the effects team began to sort through various approaches to the head explosion and regenerating effect. The first thing we had to determine was what to make it look like when it exploded without completely horrifying people, commented Jacqui Lopez. We couldn't have anything too violent or too gory. The next question was, how should it grow back? Did we want it to be like an embryo head that grows into a full human? Or should we make it more of an alien growing into its disguise as a human? We were certain of two things: we didn't want it simply to be a small head growing into a larger one, and we didn't want it to look like a morph. We wanted Jeebs to grow his features one by one.

CG supervisor Carl Frederick was involved in planning the sequence. We figured Jeebs head being blown off wouldn't be too hard because it was such a quick event, Frederick remarked. The explosion happens in just a few frames. The difficult part was having the head reform on camera. The decision was made to base the shot on a plate of Tony Shalhoub performing in full makeup, then match the footage with a CG model of the character. Aside from the match, we were aware that the look of the animation was going to

Agent Jay cradles a newborn alien constructed by the Cinovation team.

be tricky because everyone knows what human beings look like and when you do something wrong, it's very apparent. The brevity of the scene was another concern; the head had to grow from something very small into a fully formed character within a matter of frames. "We devised a lot of interesting events to happen during the transformation. It wasn't just one shape forming into another, it was many different shapes developing along the way with ears popping out and eyes bulging. Initially, there were no plans to have Jeebs speak during the scene, but it just didn't have the oomph that we wanted. So we decided to continue the shot through the point where Tony began speaking during the live-action, and match his speech with the CG version."

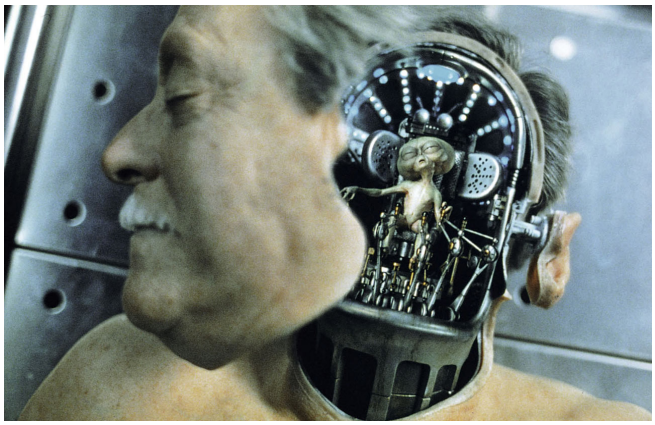
The daunting task of modeling and animating the computer generated Jeebs was assigned to Tony Hudson contrary to the usual ILM practice of delegating the CG elements into two different departments. "We needed someone who could handle both the modeling and animating aspects of the shot," said Brevig, "and Tony was definitely the guy to do it. We told him he could build it any way he wanted to. He could take all the shortcuts he chose, because we weren't making a model that was going to be distributed to other animators for different shots. When we do that, the modeler has to follow an organizational strategy so that anyone who picks up the shot can easily identify hundreds of potential animation points. Tony could keep all that information in his head and build it any way he wanted because he was the only person who had to make it work."

Beginning with the Cinovation makeup design, CG modeler Steve Alpin and Hudson created a digital model and matched it to the live-action plate. Hudson then animated a three-dimensional transformation that started with a tiny, bug-eyed alien head, growing up and out of the jagged neck, and eventually formed into Shalhoub's head as he was speaking dialogue from the original plate. At that juncture, Hudson interpolated between the two models to get the basic shape causing the head to grow from small to huge and animated it, incorporating facial expressions and mouth articulations. "I added all kinds of motions and asymmetry to the scale," related Hudson, "so that rather than just scaling up smoothly, as in a 2-D morph, the neck stretched up first, and then the head jerked from side to side and the ears popped out at odd moments. Then, as he was speaking the dialogue, his mouth grew out disproportionately. After that, the rest of the head scaled up to match every- thing else."

Although Shalhoub's head was rotoscoped out and replaced with the constantly transforming CG sculpture, his actual body remained in the shot the entire time. Then, seven frames before the end of the cut, Hudson created a transitional model that precisely matched the actor's head in the original plate. "My CG model had to match exactly with Tony Shalhoub on one frame. We literally cut from frame 129, which was the CG head, to 130 where it was the actor's real head with no cuts away or big things suddenly walking in front of the camera. It was quite a challenge dealing with lip articulation on a scaling head, while still retaining the character of Tony's performance."

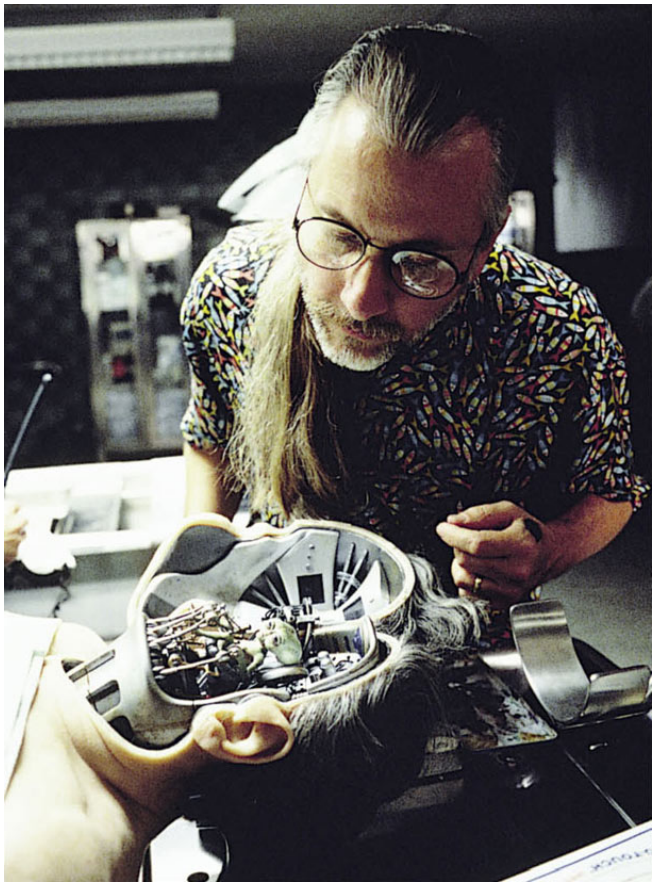
Hudson and technical director Henry Preston both wrestled with the complexities of trying to simulate human flesh. "Henry really had his hands full," affirmed Hudson. "The look of the

flesh was to begin as a smooth alien embryo head, evolve into bumpy, crawling flesh, and finally transition into the live-action. It was an extremely difficult task to get not only the hair and eyes to be photorealistic, but the human flesh as well, because the qualities of human flesh are known to everyone. Transparency and textures were especially tricky. Since the scale of the textures was changing so rapidly, it was difficult to get the look to animate smoothly with the head animation. An additional distortion was added to the top to make the skin appear as if it were alive and growing into its final form. This was probably the closest we have ever come to simulating an actor full screen.



A bizarre autopsy reveals a tiny alien operating a human body from a small control room inside the skull.

Immediately following the scene at the pawnshop, the story moves to a desolate farmhouse in upstate New York where a foul-tempered farmer named Edgar (Vincent D'Onofrio) is berating his long-suffering wife, Beatrice. Just as he informs her that she is useless and that the only thing that pulls its weight around there is his pickup truck a blazing fireball plummets from the sky, snaps off a couple of trees, and crashes through the aforementioned vehicle. When Edgar goes outside to investigate, he discovers that the meteorite is actually an alien spacecraft one containing a particularly nasty alien. An enormous insect pincer snatches Edgar off his feet and yanks him into the crater. Then, after some off-screen mayhem, the alien emerges wearing the farmer's skin as a disguise. The crashing saucer effect was achieved through the collaboration of computer graphics imaging guided by Carl Frederick and live-action plate photography, filmed on location in Southern California under the supervision of Peter Chesney, who also served as second unit director for the shot.



To accomplish the physical reaction of the CG saucer slamming into the pickup, Chesney and crew dug a nine-foot-deep crater that measured twenty-five feet in diameter, over which they built and dressed a breakaway floor. The truck was balanced on a stack of wooden boxes in the middle of the hole, and a 4000-pound wrecking ball rigged with ten 300-watt bulbs for interactive lighting was then dropped from a height of ninety feet onto the vehicle, completely crushing it and driving it into the ground. Air rams under the

surface of the dirt lifted the crater walls around the perimeter, and a background tree was ignited on cue.

Cinovation built the head and the alien within, while ILM fabricated the control booth interior. Rick Baker examines the work.

Wearing his human disguise none too nattily, the alien enters the farmhouse and is told by Beatrice that his skin is hanging from his bones. He pulls the back of his head as if stretching a length of pizza dough and tightens his facial features into a semblance of order. The skin-stretching effect, along with Edgar's slow decomposition throughout the film, was created as a multi-stage makeup by Rick Baker. "I started out by learning how much abuse Vincent could take," Baker related. "He had incredibly loose skin that he could move all around – which was great – and he had no problem with us stretching and pulling him, and then gluing him down in weird places. We attached silk to his face – very much like you do with temporary facelifts on actors and actresses to make them look younger – and ran the thread up through a silicone pate to a handle he could use to actually pull his own skin."

The first stage of the makeup entailed gluing D'Onofrio's eyelids down and affixing a neck appliance made of the same, loose-fitting silicone gel used for breast implants. "The silicone gel was translucent and heavy, and made neat, very fleshy folds. It also handled a bit like liver – which made it difficult to work with. We made the neck piece oversized so it fit loosely and buckled like loose skin beneath his jaw line." Quarter-inch gelatin appliances, made by Kazu Tsugi, were placed on D'Onofrio's cheeks to conceal where his eyes had been pulled down, while separate pieces covered his eyelids. The eyebrows and beard stubble were all applied by hand, and hair was hand punched into the special pate – which became more sparse as the film progressed. Along with corrupted dental appliances, plumpers were inserted in the actor's mouth to distort its shape. Altogether, the make- up required as long as six hours to apply.

The next scene takes us to the Men in Black Headquarters, where Edwards is given a tour of the building and initiated into the exclusive ranks of the Men in Black. Bo Welch designed the set in a sleek, futuristic motif – as if conceived by the technological visionaries of the early sixties. The highly-detailed set was built on Stage 15 at Sony Studios and featured a large mural of the 1964 World's Fair that included the image of two flying- saucer-mounted towers which – according to the storyline – represent the first two flying saucers confiscated by the newly-formed agency back in 1961.

To achieve the desired level of performance, a larger alien was needed. ILMmodelmakers Howie Weed and Mark Siegel fabricate a scaled-up control booth to house the oversize Cinovation puppet.

As they make their way through the structure, Agent Kay stops by the break room where Edwards is introduced to a couple of decidedly nonhuman forms having a smoke and a cup of joe. Dubbed the "worm guys," these diminutive creatures were cable- and rod-operated puppets designed by Baker and longtime crew member Aaron Sims early in preproduction. "I

wanted to do a creature that could not possibly be a man in a suit,&#65533; Baker remarked, &#65533;and the worm guys evolved from that notion. Aaron did a Photoshop composite of a test puppet in different poses &#65533; one drinking coffee, one smoking a cigarette and leaning up against the counter, and one pouring the coffee into a cup &#65533; and I told Barry that the worm guys could perform on the set during principal photography. He liked the idea very much and we ended up making four of them.&#65533;

Each worm guy measured approximately three feet in height and featured a tan-colored body with two main legs and two main arms capable of movement. Smaller appendages ran up and down the length of the torso. Though functions were limited, each was capable of specific actions like smoking a cigarette or pouring coffee into a cup. &#65533;The puppeteers really brought a lot to the performance,&#65533; said Baker. &#65533;They spoke in their own kind of &#65533;alien speak,&#65533; and came up with some very funny routines. Each worm guy required two puppeteers, one of whom was Jurgen Heimann, who did the original mechanics. The puppets were cable- and radio-controlled, and some had rods that came through the cabinet in the lunchroom set.&#65533; The characters were so popular that computer generated versions were created by Steve Alpin and Bridget Goodman at ILM and animated for two additional cameo appearances in the film.

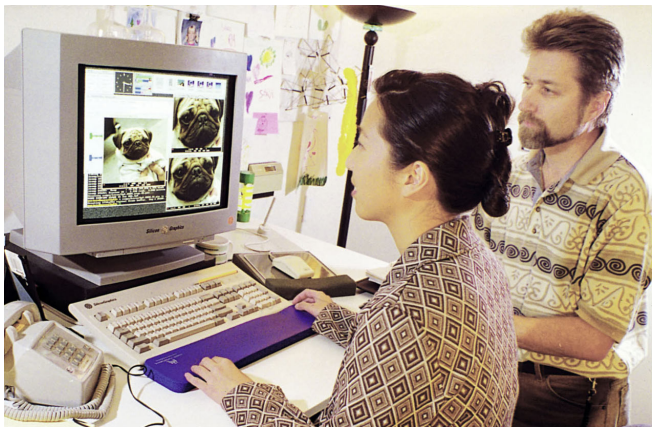
During the tour, Edwards is given a crash course in alien technology when he accidentally touches an innocuous-looking yellow ball on display in the storage room. The ball shoots off like a bullet and ricochets throughout the headquarters in a scene directed by Eric Brevig, who served as second unit director on the film. &#65533;It was a very funny sequence,&#65533; Brevig recalled, &#65533;but it was hard to do because we had to choreograph a nonexistent element &#65533; along with a lot of extras and actors and physical effects people with trip wires on things. We had to establish a precise cadence to the shot, which was tricky, but compared to the kinds of effects we usually do, it was a lot of fun &#65533; like regular movie making.&#65533; The physical appearance of the ball was not determined until well into postproduction. &#65533;We shot the original footage knowing that as long as we didn&#65533;t show anything physically representing the ball, we could design it later in post. The yellow ball ended up being faceted and measuring about the size of an orange. It looked a little bit like crystal with light reflections on it, and it pulsed whenever it hit something.&#65533;

Well into the seventeen-week shoot, it became apparent that the Men in Black Headquarters was noticeably lacking in alien lifeforms. Although it was intended to represent an earthly way station, the building hosted a mere handful of extraterrestrials. The producers realized that the setting was perfect for a Star Wars Cantina style sequence &#65533; wherein exotic characters could be introduced in a casual manner &#65533; and commissioned some additional aliens for the scene. With only six weeks remaining until the scheduled shoot, however, it was impossible for the Cinovation team to assemble the requisite beings in time, and Baker was forced to turn to several outside facilities for help. &#65533;I had never needed to subcontract a job before,&#65533; Baker admitted, &#65533;and I felt uncomfortable about doing so. I begged Barry to reschedule it, but it just wasn&#65533;t possible. The frustrating thing was that if the concept had been approved early on, we could have had dozens of creatures ready on time. But at this point there was no way &#65533; with all the construction we still had to do &#65533; that we could get it all done.&#65533; Baker presented

Sonnenfeld with a portfolio of designs, the director made his selections, and Baker transferred their fabrication to three separate effects houses.

Visual effects supervisor Eric Brevig with effects art director Benton Jew oversaw the miniature and digital work at ILM.

Among the new aliens were a tiny father and son, seen among a group of intergalactic travelers waiting in a passport control line for admission to earth. Their amphibianlike makeup was assigned to Bart Mixon and Earl Ellis, of ME*FX, who created full, foam latex costumes with radio-controlled heads. We tried to do something different with the eyes, said Ellis. They had a big membrane covering the eyeball, and the eye blinked on the inside of the membrane, just to make them look a little more alien. Each creature required two puppeteers per head, one to operate the eyes while the other controlled the O-shaped mouth.



Technical director Robert Marinic and assistant technical director Polly Ing examine a shot of the talking pug alien.

Servo mechanisms packed tightly into the small head casings permitted a variety of facial expressions. We wanted to stay as true to Rick s character designs as possible, said Mixon, but that meant there wasn t much room inside the head pieces. It was a real trick to get all the servos installed and to run the articulating mechanisms around to the mouth. We kept everything small so they didn t get too fat.

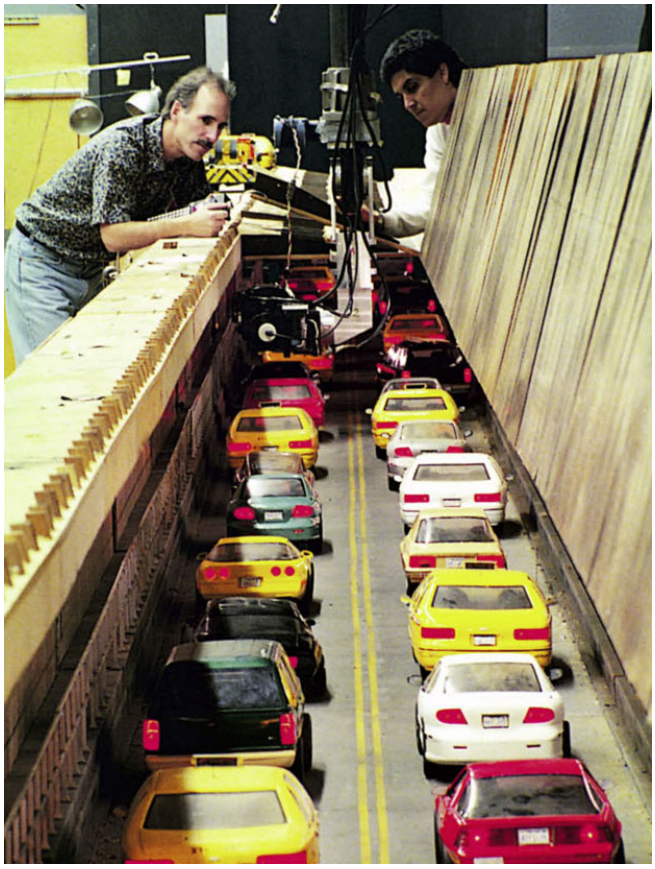
Steve Johnson s XFX also contributed aliens to the sequence, the first of which was a briefly-glimpsed extraterrestrial waiting in the same passport control line. Dubbed Scared Guy by the crew, the alien was adapted from an original Rick Baker design. Scared Guy was human sized, related Johnson, so we always intended him to be a man in a suit, but the head featured some heavy articulation by Eric Fiedler. The eye stalks moved around independently and together and the eyeballs moved inside the stalks. Both the upper and lower eyelids blinked. Scared Guy had a series of gills that extended from his mouth to his nose, which were capable of a nice rippling motion. Although we never got to use it on set, his mouth had lip-sync articulation, with side-to-side jaw movement. Taishiro Kiya, who worked with me in developing the creature, did the original sculpture and final paint work.

XFX s second offering was Slug Guy, an amorphous, undulating, green and pink mass, measuring approximately ten feet in height. We wanted Slug Guy to be translucent, related Johnson, so I convinced Rick to let me use a technique that we had begun on Species, which involved the manipulation of plastic bags. It was developed by Bill Bryan. He built a rig that he

could sit on, and motivated it simply by moving his feet forward like sitting on a tricycle, but not pedaling. A hand-held device controlled the head; and by moving it manually, Bill could make Slug Guy sniff the ground or lift its head around in different directions. The creature had tentacles set up on a positive-negative vacuum system; and as Bill scuttled forward, they would spread out and then constrict. The tentacles were also attached to a wheel-based cam, so they would go up and flop down in a cyclical movement.

For a scene in which the agents supercar drives on the walls and ceiling of a gridlocked tunnel, ILM composited a CG vehicle into miniature tunnel footage. Modelmaker Ira Keeler carves a study model of the car.

The final XFX creature was a jellyfishlike being contained within a mobile aquarium built by Peter Chesney. The aquatic alien was designed and built by Lennie MacDonald and Nori Honda to function entirely within a liquid environment. Formed of translucent silicone and equipped with underwater servos, the creature also had remote control light sources and an internal color wheel that caused it to change color and intensity on cue. "There were several functions that allowed it to move up and down and side to side," explained Johnson, "and tentacles that curled and extended independently. It was a beautiful piece that could swim around the aquarium by itself."



Effects director of photography Pat Sweeney, with gaffer Mike Olague, programs a motion control tunnel shot.

Under the supervision of Greg Nicotero and Howard Berger, KNB EFX Group also made some additions to the headquarters milieu, beginning with two floor-hugging, football-sized creatures called "scrubba-bubbles." "The design was based on the scrubbing bubbles from the old Dow bathroom cleaner commercials," said Nicotero, "which was what they resembled. Bill Zahn sculpted a fiberglass helmet and added a foam latex skirt that looked like little tentacles coming out of the bottom — which disguised the fact that they were fitted over radio-controlled cars built by Larry Odien. They basically puttered around the set. The shells were painted a tannish-brown with lots of pearlescent pinks and blues; so when you looked at them, your eye was always moving to the different colors."

KNB also generated the two multi-tentacled creatures that operated the keyboard for the egg-shaped monitor screens prominently featured in the headquarters set. Nicknamed the "squid guys," the four-foot characters were cable-operated puppets built on stalklike bodies with eight separate tentacles each. "They looked like flowers with all the petals opened," remarked Nicotero. "There was a crater in the center of each body, and out of the crater came an eyeball on a stalk. Garrett Immell sculpted the maquette — which went through several modifications before it was approved — along with the full-scale model. Tim Ralston and Wayne Toth were responsible for building the mechanisms — which were not overly complicated, but it took a lot of time to make all of the segmented joints for sixteen tentacles and two eye stalks. Dave Nelson — of Animated Engineering — built four-way joystick controllers for each of the tentacles, which gave us a lot of control over their movement." At two puppeteers per tentacle, a total of eighteen people was required to operate each squid guy. The stalk was also cable operated, along with the eye, which was made from two vacuformed spheres filled with a yellow liquid. "There was an RC motor with a stalk and a little black tip that actually made contact

with the vacuformed sphere. It looked like an eyeball floating in yellow fluid.&#65533; The squid guys were finished in shades of porpoise blue, with lighter tones airbrushed on for texture. Each of the two-and-a-half-foot tentacles was then flocked with lines of reddish cilia.

In a departure from Baker&#65533;s custom of having his Cinovation crew puppeteer the work themselves, a team of outside puppeteers was assembled for the show. &#65533;We usually puppeteer everything ourselves because the guys in the shop are so familiar with their own work. Practicing and playing with the creatures is part of the job. But on Men in Black, we still had so many things to build &#65533; and so little time &#65533; that I couldn&#65533;t afford to have all my mechanical guys on the set sitting around waiting to puppeteer. So I went to Tony Urbano, who did such great work with the robot on Short Circuit, and asked him to be our &#65533;puppeteer wrangler.&#65533; He knew lots of puppeteers and had auditions to build up a pool of performers who ended up puppeteering most of the creatures on the show. They were very talented actors, and I was very pleased with their work &#65533; as was Barry.&#65533;

During postproduction, several computer generated aliens were also commissioned to augment the headquarters sequence. &#65533;After we had a good look at the footage, it turned out that the scene was lacking something,&#65533; remarked Eric Brevig. &#65533;It needed aliens that could not possibly have been played by a mechanical creature or a person in a suit. Knowing this might happen early on, we shot plates that could be used as effects backgrounds. Then, in postproduction, Tony Hudson modeled two outrageously nonhuman creatures, which Mark Cho animated, together with the worm guys, interweaving them among this crowd of aliens and humans milling about the headquarters.&#65533;

Technical director Joel Aron at work on the CG supercar, which transforms from a street model Ford LTD.

Shortly after Edwards is initiated into the Men in Black agency &#65533; erasing his former identity and becoming Agent Jay &#65533; he and Kay are dispatched to intercept an alien, known as Redgick, who is illegally exiting Manhattan. They stop Redgick&#65533;s vehicle and interrogate the nervous alien, who informs them that his wife is about to have a baby. Kay sends Jay to the car to assist in the delivery while he questions the frantic husband. Under the skin, Mrs. Redgick turns out to be a tentacled creature and &#65533; in the throes of childbirth &#65533; she reaches out of the car and grabs the unwitting Jay, tossing him into the air and flailing him about wildly. The computer generated effect employed live-action plates shot on location in New York, along with bluescreen elements filmed on stage.

The sequence was supervised by John Berton and animated by Glenn Sylvester. &#65533;The Redgick sequence was a good example of the connection between computer graphics and live-action photography,&#65533; noted Berton. &#65533;The script called for Will Smith to be grabbed by this lizardlike creature and thrashed around in the background, while Kay talks to Redgick in the foreground. So our first question was, how should we do it? Should we create an all-CG replication of Will

Smith &#65533; because it might be safer and we&#65533;d have more control &#65533; or should we do a bluescreen composite? Glenn did an animatic with Will and the tentacle out of focus in the background, and stand-in CG characters in the foreground. That went to Barry, and he designed the shot around it. Barry liked it so much, in fact, that he decided he didn&#65533;t want the background out of focus &#65533; he wanted to see the full action between Will Smith and the tentacle. That made it much more difficult for us because we weren&#65533;t really sure we could carry off a CG Will Smith, who happens to be a very manneristic actor. We decided to shoot a lot of footage of him on a wire rig against bluescreen, and fill in the more difficult parts with a CG stand-in. But as we went through the movie, we realized what a tremendous physical actor Will is. By the time we got to the bluescreen, we wanted to let him act the scene. He had far too much ability for us to replace him with a CG character.&#65533;

Choreography for the wire rig was derived from the CG animatic. &#65533;All of Will&#65533;s action had been predetermined,&#65533; continued Berton, &#65533;so during bluescreen photography, we tried to puppeteer him in a manner consistent with what had already been established in the animatic. That way, he was free to flail around while we took care of his basic positioning.&#65533; The next critical step was compositing the bluescreen footage into the background plate &#65533; while back-animating the computer graphics tentacle into the shot. &#65533;The trick was propelling Will with the motion that he already had inherited from the wires. We couldn&#65533;t change his fundamental action because of motion blur, yet we had to find a way of making the tentacle look like it was controlling the movement. After we had captured enough footage, we chose the takes we liked and linked them all together into something that made sense, using a little two-dimensional repositioning of the elements.&#65533; The animated tentacle was then composited into the 700-frame shot, with the precise amount of motion blur, shadows and light supplied by technical director Ken McGaugh.

The Redgicks&#65533; newborn was designed and built at Cinovation under team leader Jose Fernandez and mechanical designer Mike Elizalde. &#65533;The script described the Redgicks as reptilian,&#65533; noted Baker, &#65533;but I thought it would be interesting for the baby to have a cute face. We ended up making two versions of it. One was a loose-jointed, silicone-filled dummy used for stunts, while the other was fully articulated, with working tentacles and blinking eyes. Stretched out, the baby measured approximately three feet in length. The main body was like a forked tentacle, and there were quite a few hairlike tentacles on its head. It actually vomited on Will Smith, who was a really good sport about it. We got him several times, smack in the face, with methylcellulose and oatmeal.&#65533;

Not long after the roadside delivery, the action returns to the city where an elderly jeweler named Rosenberg actually the exiled high prince of the Baltians meets the Arquillian ambassador for lunch at a diner. They are joined by Rosenberg's pet cat, who accompanies him everywhere. A rapidly decomposing Edgar dons a waiter's uniform, and just as the ambassadors are about to reach a peace accord after eons of fighting his stingerlike tail whips out and stabs each, in turn, through the neck. The animated tail was layered into the shot during postproduction at ILM.

Modelmakers Gabe Olson, Steve Gawley and Chuck Wiley paint a nine-foot-diameter flying saucer for a scene in which the alien Edgar attempts to make off with a stolen galaxy.

The aliens' bodies are removed to the morgue where an autopsy is performed by Dr. Laurel Weaver (Linda Fiorentino), who discovers the Arquillian's inhuman body parts and notices strange stitching around the base of Rosenberg's ear. A turn of the ear opens the man's head like the face of a locket, revealing the true nature of the Baltian prince. He is, in fact, a little green man operating his human disguise from inside Rosenberg's head.

Both the exterior of Rosenberg's head and the little green man dubbed Chucky were built in two different scales by Cinovation, under supervisors Jose Fernandez and Aaron Sims, starting with an unnervingly lifelike head based on a cast of the actor. It was interesting when we shot the scene in the morgue, said Baker, because the head and body looked like those of a real man. People were fascinated. Then, all of a sudden, the ear popped out and the face opened up and steam came out and there was a little green man inside doing a death scene. The interior of the head built by ILM was dressed like a tiny control booth, complete with miniature Casio television monitors, and housed a real-scale, cable-operated Chucky puppet. Because the creature was so small, however, it was necessary to construct an oversized, four-foot insert version to obtain the desired level of performance.

The larger Chucky was sent to ILM, where it was placed within an eight-foot head interior fashioned by modelmakers Carol Bauman, Mark Siegel, Danny Wagner and Howie Weed. Jon Foreman contributed the electronic and mechanical elements that replicated the original, head-sized control booth. We used lip-sync for the shot, explained Baker, which was very hard to do with a puppet. To make things easier, we preprogrammed the same dialogue used during the live-action shoot. My head mechanical engineer, Mark Setrakian who built the mechanism and puppeteered the little version of Chucky had done the voice when we shot the scene with the principal actors. He also puppeteered the large-scale version at ILM, so we simply used the same track of him doing the voice. Mark modified our motion control system using Midi software so that we could tweak and adjust the computer sequencing to repeat the lip-sync precisely every time.

As the diminutive Baltian lies near death, he manages to offer a final, cryptic message: to avoid war, Jay must find the galaxy on Orion's Belt. The Men in Black return to headquarters, where sirens and flashing lights proclaim a mass alien exodus. To make matters worse, an Arquillian battle cruiser has moved into orbit around earth and is threatening to attack. Kay and Jay quickly move into action picking up a small arsenal of alien weapons on their way out the door and go to look for an extraterrestrial named Frank, who is a master of galactic politics. As it turns out, Frank is disguised as a small pug dog, kept by the ghoulish owner of a key kiosk. Impatient with Frank's reticence, Kay lifts him by the neck and shakes him until he begins talking.

The talking pug scenes combined background plates of a real dog with computer generated lip movement animated by ILM under the guidance of CG supervisor Robert Marinic. Although the choice of a pug was not deliberate in terms of facilitating the ease of the effect, the animal's natural facial creases provided an ideal matte line for the animators, making it possible to manipulate the muzzle area while leaving the remaining face intact. "We only had to build a model of the nose, cheeks, jowls and lower jaw," explained Marinic. "After that, we took the background plate and applied it as a texture, choosing the frame that had the least amount of motion blur. We made some paint modifications, then applied it to the model and used Cari animation to create the lip movement." Modeler James Doherty constructed the new muzzle and mouth interior for the dog, while Rob Coleman oversaw the animation of the eleven talking dog shots.

The ILM stage crew prepares to crash the saucer into a replica of the Unisphere from the New York World's Fair.

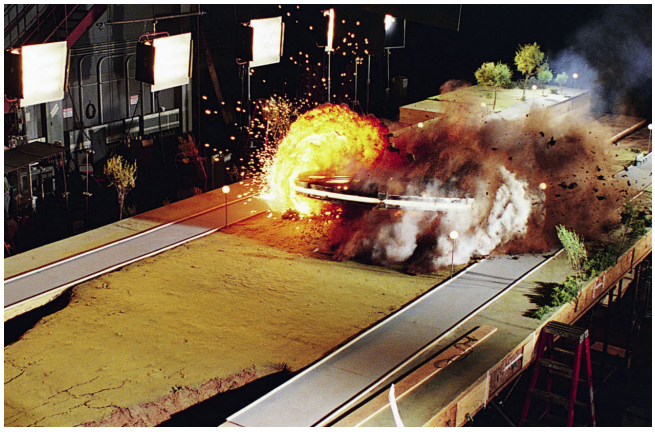
Determining a realistic level of lip movement proved the biggest challenge. “It started out too cartoony,” commented Brevig. “The animators had the tools, so initially they used everything. When we looked at the initial tests, we thought, “Okay, it looks like he’s talking, but why doesn’t it look like a dog is talking?” We had to look at pugs’ mouths quite a bit during this project. One day, Rob and I were trying to wrestle this dog’s mouth so we could count his teeth. He had such big, floppy, loose jowls that we could move his skin all over and his head didn’t move ” which showed us exactly what to do. Rob suggested that we make the movement very soft, and take the animation way down. Suddenly, it looked like the real dog talking and not like a computer generated mouth.”

Pyrotechnics and a hydraulic cable rig contributed to the effect.

Frank the Pug informs the agents that the third galaxy is not in the constellation Orion’s Belt, but here on earth. When he explains that there are tiny galaxies everywhere, they realize that the galaxy must be contained within the jeweled amulet worn, not on the belt, but the collar of Rosenberg’s cat, Orion. While Kay and Jay are having their epiphany, Laurel Weaver ” who has become the cat’s guardian ” is at the morgue discovering the remarkable jewel for herself. She becomes entranced by its beauty in a shot that reveals the diminutive cosmos for the first time. Conceived as a nebular formation of dust and gas ” while maintaining the average person’s concept of a spiral cluster ” the galaxy effect was computer generated by technical director Ken McGaugh using particle systems in combination with other ILM proprietary tricks.

In the meantime, Edgar has also solved the mystery of the galaxy and heads straight for the morgue and Rosenberg’s cat. When the Men in Black arrive, there is a violent confrontation and Edgar manages to escape ” having stolen the galaxy and kidnapped Laurel in the process. He grabs a cab and reveals his true, insectival nature to Laurel by menacing her with pincerlike mandibles. The segment was originally achieved using a practical mouthpiece built for D’Onofrio by Cinovation; but once the effect was on film, Sonnenfeld decided he wanted a different action and turned the assignment over to ILM. The animation team then painted out the practical mouthpiece, and inserted modified CG mandibles based on a computer generated model of the creature.

Chaos reigns at the Men in Black Headquarters as Kay and Jay address the implications of Edgar's escape and their supposition that he will attempt to flee in one of the flying saucers still on display at the old World's Fair site. Quickly, they leap into the LTD and head for Flushing Meadows to prevent Edgar from flying off with the tiny galaxy.



The crippled saucer plows into the ground in another miniature shot staged at ILM.

As they approach the Midtown Tunnel at top speed, a long line of cars completely blocks their passage. Kay instructs Jay to push the red button on the console, which transforms the vintage Ford into a supercar, capable of driving along the sides and ceiling of the tunnel at astronomical speeds. The computer generated supercar model was built and animated at ILM by Simon Cheung.

"All the elements of the supercar had to fold out of the LTD," related sequence supervisor John Berton. "It enlarged from the standard model into a huge vehicle with big jet engines on the back and a bubble dome. As the front end lowered, all of this alien technology emerged. We were under strict art direction not to morph, and we didn't want the car going through a bizarre shape change. We wanted it to look like it really came apart — and that it could actually fold back together again. The car transformed completely on screen — with no cutaways — and reformed at the end of the sequence when it returns to the road."

A background plate of the real Midtown Tunnel had originally been intended for use in the scene, and Peter Chesney had devised a "tunnel runner" camera rig for location filming. When coordination of the event became too unwieldy to accomplish, however, the effect was turned over to ILM director of photography Pat Sweeney, modelshop supervisor Steve Gawley and chief modelmaker Chris Reed who designed and built a miniature version of the tunnel. "The model department whipped up a beautiful eighth-scale model that was fairly accurate to the original," remarked Sweeney, "with only a few design modifications based on our specific needs. Because the supercar was required to drive along the ceiling, we altered the roof to be more rectangular than rounded. And because it was going to be moving very fast, we straightened the tunnel somewhat and expanded its length."

The completed tunnel measured three feet in width and stood nearly twenty inches tall. The roof was equipped with six-inch doors that ran in sections along the entire 96-foot length of the model, allowing camera access. "Only a couple of doors needed to be opened at a time for the camera to make it through," noted Sweeney. "With exposure times of eighteen seconds per frame, it took about an hour to go from one end to the other. We had limited access for lights because the tunnel was all enclosed and fairly flat, so we placed fluorescent lights behind the walls for a nice, soft illumination. Additionally, Steve put a separate light fixture on the tunnel walls to hide the fixtures." Fifty eighth-scale cars — made of epoxy resin — were also manufactured and dressed by Gawley and the model shop crew.

Once the miniature tunnel plates were com-plete, the CGI supercar was composited into the shot, with the final rendering and lighting accomplished under the supervision of John Berton. "We knew that the transition between the LTD and the supercar had to be seamless — and that we had to place it convincingly within the tunnel environment. With all the interactive lighting that was called for, we decided to use ray tracing instead of a scan-line algorithm, where we would have had to put up reflecting cards everywhere. The supercar, with its big chrome bumpers and moving panels, was perfect for ray tracing because self reflections were built into the program. Gerald Gutschmidt and Dan Goldman really pushed that project forward on this show — we got reflections and realism that were above and beyond what we would have been able to achieve without using a ray tracer." Bluescreen footage of Tommy Lee Jones and Will Smith — filmed in a mockup of the LTD's interior — was composited into the shot, as well.

Edgar arrives at the World's Fair site and begins climbing the tower toward the flying saucer. Laurel manages to escape his grasp and watches, unseen, as Jay and Kay come screeching up in the LTD. Kay pulls an impressive space age weapon out of the trunk and fires at the flying saucer, which is just beginning to rise from the tower with Edgar on board. The blast sends the saucer crashing through an enormous steel globe known as the Unisphere and into an adjacent park, where it churns up dirt like an Olympian plow.

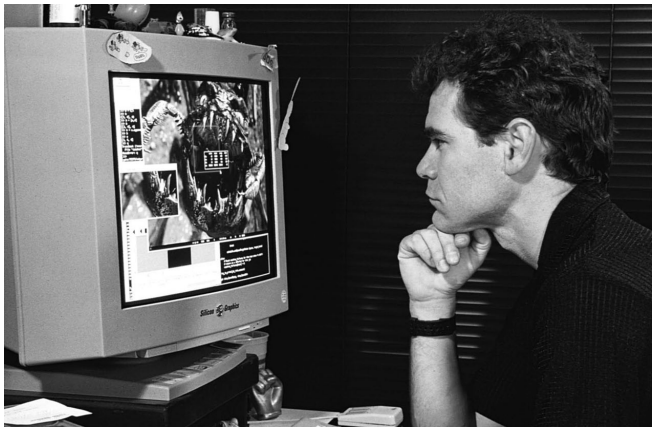
In a scene combining Cinovation makeup and ILMcomputer graphics, the alien Edgar discards his decomposing human skin to reveal his true insectlike form.

Edgar's stolen spaceship was constructed in sixth scale by the ILM model shop. The fiberglass construct measured nine feet in diameter and was reinforced to withstand the impact of the crash. "The concept was that the saucer hitting the Unisphere was the equivalent of its getting a flat tire," noted Gawley. "It generated only minimal damage, but it was still unable to fly. We used a duplicate saucer for the actual crash, but both the crash and hero saucers were equipped with practical lighting inside." Under the supervision chief modelmaker Lorne Peterson, a miniature Flushing Meadows set was fabricated — complete with lights and trees — with colored peatmoss serving as soil. Three sixth-scale Unispheres were built by chief modelmaker Rodney Morgan and crew. The structures were formed of sheet metal, similar to the kind used for air conditioning ducts, and a series of brass and plastic tubular fixtures was attached to establish the longitude and latitude lines that composed the Unisphere's external grid. The continents were cast sculptures.

The saucer crash was staged by practical effects supervisor Geoff Heron, who built a custom hydraulic rig designed to rapidly propel the craft within a relatively short distance — and stop it on a dime. "The challenge was that the spaceship had to fly thirty-five feet at a rate of thirty miles an hour," explained Heron. "And since our main stage is only ninety feet long, we didn't have a lot of buffer room for stopping. We only had about fifteen feet to bring it to a complete halt; and at thirty miles per hour, it only took about four-tenths of a second to use up

those fifteen feet. It was critical to stop it smoothly so we didn't tear apart the rig." The saucer was attached to the rig through a series of small cables, and a computer proportional valve was used for starting and stopping it on cue.

Pyrotechnics were connected to two firing circuits " one for the spacecraft and one for the Unisphere " and combined a smokeless powder base with black powder bombs, which were then enhanced with barium nitrate to lend a green cast to the explosion. "We utilized a trip on the saucer, along with some millisecond timers," noted Heron, "so as soon as the saucer hit a specific mark, it would turn on a timing circuit and start firing four different events on a preset time delay. We planned another explosion to happen right over camera." The sturdy saucer withstood a single preliminary test and two highly successful takes.



Conceived originally as an animatronic creation, Edgar Bug was eventually produced via computer generated imagery. Computer graphics supervisor Carl Frederick studies one of the shots.

Edgar emerges from his fallen spaceship and approaches the agents. Kay advises him that he is under arrest and Jay tells him to step away from his vehicle and put his hands up. Edgar reaches back behind his head and pulls the flesh away from his skull, emerging insectlike from the surviving fragments of his human shell. The sequence involved a combination of practical makeup effects and computer graphic imaging. "Rick made a breakaway back makeup that extended from Edgar's head to his waist," explained Brevig. "The scene included two cuts. When Edgar first begins to tear his skin open, the camera is on his back and we see the beginning of what we'll eventually learn is the tail of the big bug revealed inside. For the front view, Rick did a separate makeup attached to the sides of Vincent's face; and Vincent moved the entire piece with his face showing, as though it were falling away from his body. Underneath the makeup, he wore a bluescreen hood. We then put the computer graphics bug into the shot, pulling up from behind the falling-away skin. The camera pushed in on the event, keeping the true scale of it a mystery " only that it was big. There was an intermediate cut where you could see things unfold, but couldn't tell exactly what it was. That was nice, because it created a little suspense and gave the audience an opportunity to go: "Oh God, that's disgusting. What's it going to look like?""

The same question had plagued the effects team since early in preproduction. Baker, who was initially tasked with creating Edgar Bug as an animatronic character, had spent months rendering sheaves of potential creature depictions before a design was finally given the go-ahead. As with Mikey, the idea was to render Edgar Bug via both animatronics and computer graphics.

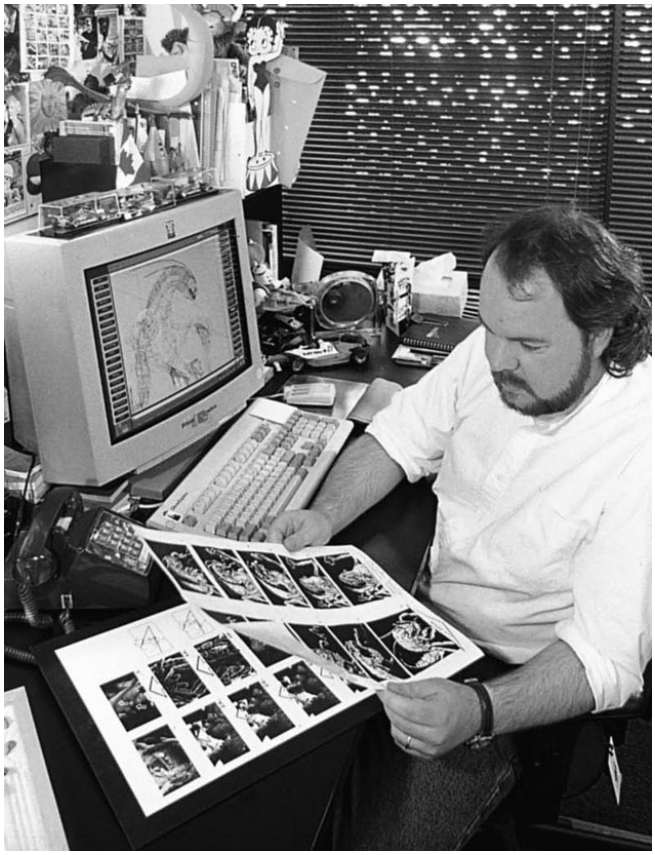
Ultimately, however, conceptual changes late in production dictated a radical change of course, and Edgar Bug was transferred exclusively to ILM, where the character was generated completely within the realm of the computer. "In the script, Edgar was always mentioned as a bug," said Baker. "There were numerous bug references throughout. So during the initial

preproduction design phase, we did a lot of drawings that looked like bugs. But Barry Sonnenfeld and Steven Spielberg seemed to have another idea in mind, and the creature evolved into something decidedly un-buglike. It became a mix-and-match kind of thing the legs from one drawing, the head from another, the torso from yet another. Eventually they approved a design that looked nothing at all like a bug, but rather more like a reptile.

After months of design purgatory, Baker and his crew were finally free to move into action. We slaved over Edgar Bug to get it ready on time. We built two highly-detailed fifteen-foot versions that were capable of all kinds of wonderful movement. But when we arrived at Sony on the day of filming, we discovered that they had rewritten the script. They now wanted the puppeteers to perform some actions that were incompatible with the creature s mechanical and physical capabilities. The tone of the film had also changed, and Edgar s design no longer made sense. Unfortunately, the decision was made not to use him at all. They turned Edgar Bug over to ILM which then went through a design and construction hell of its own.

Visual effects art director David Nakabayashi and digital model supervisor Geoff Campbell picked up where Baker left off. We had already completed our CG version of Rick s Edgar when the change was made, said Nakabayashi. The character was fully modeled and we were starting to get ready for shots so it didn t leave us much time to come up with an entirely new creature. We tried to make use of the model that existed in the computer, but we still had to do a considerable amount of redesign work on it. They wanted the creature to look more mean and vicious; and to accommodate the script revisions, he now needed to look like an insect and move like an insect. Team members Jean Bolte, Benton Jew and Derek Thompson started playing with the Edgar design altering the eyes, adding antennae, and increasing the leg count from four to six and the insect quality began to surface immediately. Digital modeler Wayne Kennedy, who had built the original Edgar Bug, was instrumental in this process, as he was able to resculpt the creature while preserving the basic geometry of the model. Enveloping the digital model a process that insures smooth and continuous movement of the skin over its underlying components was accomplished by technical director Damian Steel. Barry wanted Edgar to be comical, yet menacing, with a lot of insect characteristics such as plating, antennae and mandibles. The eyes were a major consideration. They were based on beetles eyes, with a birdlike quality added to the detail. We included tiny plates to represent the compound eye of a bug, yet gave it giant pupils that would look focused so that audiences could follow where he was looking on screen. The eyes made Edgar look somewhat comical, yet much more expressive.

One issue had remained problematic through-out the conceptual process. How could the filmmakers justify an eighteen-foot creature emerging from the body of a six-foot man? "The story has a lot of events that are physically impossible," noted Brevig. "They read just fine, but when you actually go to film them you have to resolve certain visual discrepancies " like Edgar Bug"s body coming out of Vincent D"Onofrio"s. We spent a lot of time discussing the problem. We had to lead the audience into believing it was seeing things that we weren"t really showing them " otherwise the impossibility of what we were presenting would have become immediately evident."



Animation supervisor Rob Coleman reviews storyboards for the Edgar Bug sequence.

Brevig and sequence supervisor Carl Frederick chose to solve the problem by using a time-honored special effects technique " sleight of hand. "When Edgar the bug came out of Edgar the human," said Brevig, "we played some of that in tight closeup so you saw just a piece of it unfolding. We did a slight push in, and then switched to the reactions of Will and Tommy Lee. The rest of the shots were closeups of different things unfolding " with lots of slime and ooze developed by David Meny " and more reactions from the guys. We made it enough of a montage that the audience never could judge the discrepancy in size. The implication was that Edgar was unfolding " like an insect coming out of an egg sac."

Visual effects supervisor Scott Farrar and digital effects supervisor Ellen Poon at work on the film"s cosmic zoom-out finale.

After Edgar Bug escapes his human shroud, he rears back to his full height " revealing the undiminished CGI model for the first time " and spews a wad of goo that engulfs the Men in Black and their weapons. The goo somehow adheres to Kay"s gun, which Edgar Bug pulls into his mouth and swallows. Edgar then knocks Kay and Jay into the air, and begins to climb toward the other, undamaged saucer. Knowing he must find a way to retrieve his weapon, Kay taunts the monster into ingesting him alive. Once again, the scale of the scripted action defied physical logic. "Edgar has just come out of a human-sized character," remarked Brevig, "and now he has to eat another one alive, without harming him. The secret to getting away with this was that we

carefully planned it all out so that the physically awkward moments were hidden in the cutting. We knew we wanted to see a specific series of events: first, this huge insect standing there, towering over Tommy Lee, then the insect coming down toward him, then the insect picking up Tommy Lee so that you actually see his feet go up and into Edgar Bug's mouth, and finally a top-down shot as Tommy Lee disappears down the throat. Tommy Lee was actually too big to fit into Edgar's mouth — his head and torso could never have made it. So we planned to pick him up in one angle and then, by changing angles, have him far enough in so that only his legs and feet were showing. And by shooting it in profile, the physical impossibility of the action was not apparent.

The sequence was first established as a rough animation with a CG stuntman in order to diagram the action necessary for the effect. Then, on the bluescreen stage, a stuntman was rigged to follow the same up-and-down trajectory. "We put witness marks on the bug rig and on the Kay character — which was pretty much business as usual," commented Brevig, "then rotoscoped out the rig and animated our CG bug in its place. We used the legs from the computer generated Will Smith model — which had been built as a backup for the Redgick sequence — to actually go down Edgar's throat. But the result is that the audience sees a CG bug come in and pick up Tommy Lee Jones, hoist him in the air and swallow him — all in one smooth action."

Once inside the bug's stomach, Kay retrieves his weapon and fires it, blasting Edgar Bug in half. "Edgar explodes into two pieces," Frederick related. "His upper body goes flying off camera somewhere, but then comes crawling back for another attack. The initial explosion was done as a practical shot — which gave us an idea of where to start with the effect, but it did not give us the look we were after. We had to replace the whole thing, even the background plate. The only part of the original footage we kept was Will Smith falling over, covered with slime. Technical director Gregor Lakner used particle system software to achieve the effects of the explosion: either very small, liquid-like particles, or larger chunks of flesh or viscera exploding out and landing on the grass. The larger particles then slowly folded down into the grass, which was very tough to do." A second explosion occurs after the Edgar Bug torso raises up for a counterattack and Laurel — who has picked up one of the space weapons — appears just in time to blow him to kingdom come. This time the animators were able to make better use of the live-action plate, which included a slime explosion behind the actors, although a CG blast was added to enhance the one captured during principal photography.

With the tiny galaxy returned to the Arquillians — and an unknowing planet restored to relative safety — Agent Kay decides he has had enough. He erases thirty-five years of close encounters from his memory and returns, blissfully, to civilian life. Laurel steps in as Agent Elle, Jay's new partner. The film ends with a "powers of ten" shot — a zoom out from earth, with the camera pulling back past the moon, planets, sun and galaxies. It finally stops at the interior of a marble which is scooped up by an enormous, amoebalike alien — modeled by Tony Hudson — with the implication being that our entire cosmos is merely part of a game. The shot was designed at ILM by digital artist Derek Thompson and supervised by Scott Farrar, with Pat Meyers serving as technical director.

Ultimately, Brevig and the ILM team contributed more than 440 shots to thirty different sequences throughout Men in Black, and called upon virtually every tool within their repertoire of effects techniques. The experience also provided the occasion to influence through design and computer generated awareness both the conceptual and cinematic aspects of the film. It s difficult enough for a director to communicate with an actor on a set and arrive at the common understanding of an idea, concluded Brevig. But a director communicating with a character that exists only within the reality of a computer and is brought to life by an entire team of artists offers a special set of challenges. We came to a real understanding working with Barry, and the secret was in interpreting his direction. He did not know nor need to know the correct technological terms to get what he was after. We agreed about this early on, and I made a real point not to speak techno-babble during our conversations. Barry simply expressed himself to us as a director talking to an actor, and we took it from there. We had some really smart people working on this show who were especially gifted at translating the technical elements into eloquent visual images. By allowing them creative freedom, their raw talent had the opportunity to emerge fully on the screen.

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CON AIR SKYJINKS

ARTICLE BY Matthew J. MacDonald

In the past decade, producer Jerry Bruckheimer – together with his late partner Don Simpson – has built a reputation for creating audience-pleasing, high-octane action movies such as Top Gun, Crimson Tide, Days of Thunder and The Rock. Now, with first-time feature director Simon West and backing from The Walt Disney Studios, Bruckheimer is aiming to extend his list of hits with Con Air, a supercharged story that revolves around the aerial transportation of criminals from one holding facility to another by the U.S. Marshals Service.

As the picture opens, a C-123 Provider plane – nicknamed the 'Jailbird' – is boarded by a motley crew of murderers, thieves and rapists, including Cyrus 'The Virus' Grissom (John Malkovich), a sociopath who has been promised a healthy sum of cash to commandeer the aircraft and expedite the liberation of a convicted drug lord. Also on board is Cameron Poe (Nicholas Cage), a parolee and former decorated Army Ranger who has just completed an eight-year sentence. When Grissom and his inmate troops take over the plane in flight, Poe forms an unlikely alliance with ground-based marshal Vince Larkin (John Cusack) to stabilize the dangerous situation and regain control of the plane.

Extensive footage of the C-123 – both air-to- air and ground-based – was mandated by the airborne storyline. Aerial plates were shot over the desert near the Utah/Nevada border by the production first unit, aided by the Spacecam photography group. In addition, physical effects supervisor Paul Lombardi constructed a full-size interior mockup – mounted on a motion base – that was filmed against bluescreen to capture live footage of the actors interacting aboard the doomed military transport plane.

Not every sequence could be realized through live-action or full-scale physical effects means, however. Dream Quest Images was commissioned to handle the film's visual effects slate, which consisted primarily of shots of a jail house explosion, the C-123 in peril and a climactic crash into the Las Vegas Strip. The assignment was helmed by visual effects supervisor David Goldberg, with model shop chief Mike Stuart overseeing an extensive model build, and CG supervisor Darin Hollings and compositing supervisor Marlo Pabon guiding the digital effort. Of the company's hundred-plus effects shots, approximately sixty-five percent involved model photography – either motion-control, high-speed or a combination of both – while fifteen percent were purely computer generated. Nearly every shot required some degree of digital enhancement or manipulation, however, and all of the effects were composited digitally. "In addition to our shots," Goldberg explained, "there were about sixty wire and rig removals that were done by Computer Film Company. There was so much of that stuff, we just couldn't handle it all."

From the start, it was clear that models would have to be employed for nearly every major effects sequence in the film – a fact that had initially concerned Simon West. "Going into this film," noted Goldberg, "the director didn't want to use miniatures any more than he absolutely

had to. He was very worried about how they might cut in with the live stuff. He wanted, as any director would, to put the full-size mockup or the real plane into shots where the plane was supposed to be in jeopardy; but eventually we convinced him that model work, done right, would be a much better approach."

Dream Quest Images provided visual effects for Con Air – about a group of dangerous convicts who commandeer a C-123 airplane transporting them from one prison to another.

Con Air's first major effects sequence occurs when Larkin, accompanied by three prison guards, finds documents pertaining to the transport plane, together with a box marked 'Do Not Open,' hidden in the wall of a cell previously inhabited by Grissom. When one of the guards disregards the warning and opens the mysterious box, a huge explosion blasts him across the room and blows out The Cell door. The sequence was filmed at the new – and, at the time, unoccupied – Twin Towers jail in downtown Los Angeles. "We shot the actor playing the guard," stated Goldberg, "pulling him out of The Cell very quickly with a physical effects ratchet gag to make it look as if he was being blown across the room. We then shot the explosions at a different location. When we put the shot together, we painted out the cables pulling the guard and then rotoscoped the explosion elements to look as if they were coming from the box and then engulfing him."

For an establishing shot of a military convoy approaching an aircraft graveyard, Matte World Digital created a digital matte painting to expand the minimally dressed location set.

For the flying cell door, a CG door was modeled and animated in Alias/Wavefront Power Animator to careen down the corridor toward camera. "We got the door from the actual jail," Darin Hollings said, "took photographs of each side of it, scanned the photographs and then mapped them onto the CG door. I also had a piece of foamcore blow-torched, took a photo of it, scanned the photo and mapped it onto the door to get a scorched texture."

Featured later in the film is an effects sequence in which the convicts – having taken control of the C-123 with cutthroat precision – touch down at a desert airfield to refuel. There a National Guard convoy is ambushed as it attempts to intercept the escapees. For a master shot of the airfield and its adjacent airplane graveyard, Dream Quest engaged Matte World Digital to expand the Nevada desert location site which had been dressed with junked aircraft pieces. Chris Evans

and Paul Rivera created a matching digital matte painting to extend the graveyard and create the narrow road down the mid- dle that would serve as a trap for the approaching convoy. “The Military Aircraft Storage and Disposition Center at Davis-Monthan Air Force Base in Arizona was our inspiration,” stated Matte World founder Craig Barron, who went there to photograph reference elements. “We also used models, built by John Duncan, of civilian aircraft parts to further develop the look of the shot.” Completing the effect was animated dust and a CG element – created by Morgan Trotter – of the truck convoy approaching in the distance.

To catch up with the temporarily grounded airplane, Larkin hot-wires a classic 1967 Corvette convertible and gives chase. In the midst of a firefight between law officials and the convicts, the aircraft takes off, trailing a tow cable which inadvertently snags the Corvette and pulls it aloft. The dangling sports car is smashed to pieces when it impacts with the airfield control tower.

Shots of the car being towed by the airplane before liftoff were accomplished with both a real plane and a real Corvette, while a mockup vehicle – built by the physical effects crew – was used for shots of the control tower impact. For views of the airborne Corvette, however, a 3-D computer generated model was built and composited into live-action shots of the plane. “We had the real Corvette delivered to Viewpoint DataLabs in Utah,” stated Hollings, “which, conveniently, was only about an hour away from where production was shooting. Viewpoint digitized the car and produced a computer model of it – the underside, the top, the interior, the whole thing.”

While Viewpoint provided the essential form, Hollings and his team were responsible for creating a photorealistic exterior for the vehicle, which would be seen in broad daylight against a bright blue sky. “I went to Utah to take pictures of the car on movie stock,” Hollings recalled, “as well as pictures of the sky in all four directions – north, south, east and west – on the days that production was shooting. I also took pictures of a chrome ball from the top, the bottom and both sides to capture the lighting. When I returned, I put those photographs together into a computer sphere, which I used as my ambient light on the CG Corvette so that appropriate colors would shine in all four directions. The light that struck the bottom of the digital car was sand-colored, while the ambient light that hit the sides and top was the color of the sky.” In the final rendering of the sports car, the sun’s position was suggested through appropriate reflectivity. “The CG Corvette was made up of a lot of different layers in the final render – color layers, glint layers, chrome layers – and the compositor could make those layers brighter or darker as the car’s position relative to the sun changed. There were little glints and flashes that really brought the car to life.”

To make the firefight aftermath more dramatic, the CG team also added computer generated smoke and exhaust fumes streaming from the damaged right engine of the C-123. “After the plane is shot up at the airfield,” stated Hollings, “it is supposed to be trailing smoke. But some of the shots done with the real plane didn’t have any trailing smoke; so we added CG smoke to about eight or nine of those shots. You don’t think of things like that as big CG shots – but they’re actually very time consuming.” The creation of the smoke fell primarily to digital artist David Wainstain, who used Power Animator’s particle system program and a custom particle emitter to generate the effect. “One of the problems that occurs when creating smoke with

particle systems is that sometimes particles stray away from the herd and end up looking like cotton balls. Alias/Wavefront has solved this problem with a function called ‘diffusion’ which calculates each particle’s position relative to the others and adjusts its size and transparency accordingly to fill in gaps. I am unaware of any other particle system that can do this.”

The C-123 suffers further damage when it is intercepted and fired upon by Cobra helicopters. To facilitate identifiably close shots of actors inside the pursuing aircraft, a real Cobra was suspended by a crane in front of a daylit forty-by-eighty-foot bluescreen. Plate photography, overseen by Dave Goldberg, was then delivered to The Computer Film Company where it was composited into desert canyon backgrounds. “The shots began to metamorphose from the moment they came in-house,” said CFC visual effects supervisor Rob Hodgson, “so by the time we finished, we had not only comped the Cobras against their backgrounds and replaced the empty windows with glass and interactive reflections, we had also added CG rotor blades and heat haze and animated tracer fire and cartridge shells. In addition, one of our designers was in close consultation with the military, which provided us with graphics information that allowed us to create a heads-up display element for several shots of the Cobra pilot locking target on the rogue C-123.”

Although production had captured aerial footage of the real C-123 aircraft for many of Con Air’s sequences, Dream Quest’s model shop provided a variety of scaled replicas as well. “For our motion control model,” explained Mike Stuart, “we built a fifteenth-scale C-123, which had a seven-foot wingspan. To get started, we looked at plans we obtained from the Smithsonian and reference photographs from military magazines; but we soon realized that those sources wouldn’t give us enough information to build our model. Over the years, the plane being used in the film had been modified a bit here and there; so I felt it was important to go out and photograph the actual airplane to get all of those little nuances. I went to Vegas a couple of times; and when the crew was servicing or cleaning the plane, I took the opportunity to shoot pictures of it and make notes.”

Using those photographs, Stuart was able to ensure absolute authenticity in the fifteenth-scale model. Dream Quest sculptor Ray Cavalluzzi carved the body out of foam, which was then surfaced in an epoxy and fiberglass cloth shell and covered with thin adhesive foils to simulate the airplane’s metallic skin. Pounce wheels – generally used to sew patterns into fabric – were employed to press tiny mock rivets into the metallic panels. “The C-123 was covered with rivets,” Stuart recalled, “and the riveted panels on our model overlapped just like they did on the real plane. Ray Cavalluzzi did the final painting and scenic work. It looked really beautiful.”

Throughout the film, the plane suffers repeated abuse, being riddled with bullets during ground and air skirmishes and further damaged in the Las Vegas Strip crash-landing. Because it would occupy so much screen time and would be presented almost as a character in the film, the plane and its deteriorating state had to be carefully matched in the miniature replications. “I wanted to make sure that our motion control model matched the real plane in proportion, texture and reflectivity,” Stuart commented. “As we shot elements for later in the story, when the C-123 is more and more distressed, we replaced parts of the model with others that we had made to look damaged, to suggest the plane was disintegrating.” For motion control photography, the model was attached to the motion control rig through either a nose or rear mount.

For shots of a car being towed aloft by the C-123, Dream Quest inserted a computer generated Corvette into plate photography of the real plane.

The crippled airplane descends upon Las Vegas, clipping the giant Hard Rock Hotel guitar sign in flight. A Dream Quest film crew prepares for the miniature shot.

As the film accelerates to its climax, the plane approaches Las Vegas on a collision course, smashing through the signature Hard Rock Hotel guitar sign before crash-landing on the Vegas Strip and plowing into the Sands Hotel. “Real airplanes were used for a lot of the shots above Vegas,” revealed Goldberg, “sometimes flying as low as five hundred feet on only one engine. The FAA wasn’t too happy about that. They gave their approval for the production to do it; but only because they didn’t quite realize what it was going to be like.”

Miniature neon for the sign was custom-made and installed by Larry Albright.

A larger, fifth-scale C-123 was constructed for the crash sequence, which would be shot on a like-scaled miniature of the Las Vegas Strip. “The fifth-scale model was built in a similar fashion to the smaller plane,” noted Stuart. “Again, the body was sculpted out of foam, then covered with epoxy and fiberglass cloth to create a skin. The real airplane has depressions in the aluminum skin which occur when the skin is fixed to the airframe. On the model, we simulated that surface by sanding in shallow grooves where the skin panels would meet and be riveted to the frame. Again, we skinned it with a thicker aluminum and created rivets using larger pounce wheels.”

For the plane’s encounter with the Hard Rock guitar sign, the hotel’s towering replica of a Fender Stratocaster was likewise reproduced in fifth scale. “We soldered together Lionel railroad track to create the form,” explained Stuart. “On top of that we put aluminum printer’s plate in sections – large panels that were lightly tacked on so they would break away when the sign got smashed.” To facilitate multiple takes of the crash, the top third of the guitar body was built out of breakaway material. Three identical guitar necks were also fabricated. “The portions of the guitar that would be backlit, like the main body, were made of thin epoxy sheets – basically our version of very brittle candy glass.” The fully constructed guitar was painted in lacquer by Dream Quest scenic artist Randy Leifer.

Miniature neon lights for the guitar, patterned after the real sign, were provided by Larry Albright, renowned for his meticulous miniature neon work. More than 556 pieces of custom 3mm neon strands and miniature lamps were manufactured for the project. “You can’t buy 3mm neon tubing,” noted Albright, “so each piece had to be handmade using special glass that we coated with phosphor, baked in a kiln, bent to the pattern and processed so that it would light up. It was a painstaking project – by far, the most elaborate we’ve ever worked on. We did neon for the mothership for Close Encounters, and it pales in comparison.” To install the lights, the sign was rigged with holes through which the neon strands could be threaded. “They were

passed through and then wired from the back. There were just rows and rows of these little electrodes and little wires. It took 140 transformers to operate all the lighting. And they had to be high-frequency, because it was shot at slow-motion speeds."

The fifth-scale sign was built so that it could be easily transported and positioned at the airport shooting site. "Even at a forty-five-degree angle," Stuart remarked, "the top of the guitar was already eighteen feet in the air. We contracted Design Setters to come up with a means of transporting the guitar out to the set and lifting it into position for filming. They constructed a flatbed trailer rig onto which the model could be mounted. It had forklift receivers on the underside because the surrounding area was cluttered with airport equipment and scenery we didn't want to see; so a forklift was used to lift our Hard Rock rig into the air an additional ten feet for shooting."

The guitar model was positioned on a tarmac area measuring approximately two hundred by five hundred feet. A hangar near the set was used as a makeshift model shop. "The Hard Rock Hotel crash sequence was filmed over the course of three evenings," said Goldberg, "each one day apart, because the redress time was fairly substantial. We filmed roughly ten minutes after sunset, while there was still some blue in the sky; so our window of opportunity was very tight."

An overhead wire rig was used for the C-123's impact with the sign. "The wire rig consisted of two large cranes – one on either side of the sign – with cables strung between them," stated Stuart. "The plane was mounted to those cables and could be made to run the length between the cranes. Just before filming, we added broken neon to the sign to create more debris upon impact. On the first take, when the model reached speed, it actually tried to fly. As a result, it missed smashing the guitar neck, only knocking off a few of the illuminated tuning keys. We adjusted for this, and went on to have two very successful takes."

A street set, also in fifth scale, was created to duplicate the Las Vegas Strip as much as possible considering that no actual casinos or hotels could be represented. “All the casinos have copyrighted names,” explained Goldberg. “They don’t mind if you film on the Strip, with those buildings showing in the background, but you can’t deliberately replicate them.” Consequently, the Dream Quest model shop was faced with creating wholly original Vegas architecture that would still capture the flavor of Las Vegas and make the set convincing.

That artistic challenge was taken up by Mike Stuart and his team, with support from miniatures art director Forrest Leathers and the modelmakers at Design Setters. Two additional companies, West On Letters and Heaven or Las Vegas, contributed Vegas-style flashing neon signs and icons. “On several of my trips to Las Vegas,” Stuart related, “I took shots of the Strip and the surrounding streets just to get a sense of what the lighting and atmosphere was. I also looked at literary sources for a lot of the architecture that exists there, past and present. We drafted those up before changing them to make each structure our own creation. Ours are different from the real buildings in Vegas, but they have the same sense and feeling. If you saw them go by in a blur, you would swear you saw a hotel you recognize from the Strip; but look closely, and you realize that it’s not.”

For scenes of the C-123 crash-landing on the Las Vegas Strip, a 280-foot-long street miniature was constructed by Design Setters, then detailed and photographed by Dream Quest. A fifth-scale model plane was either flown on cables over the set or towed along the pavement.

Leathers and his crew constructed the bulk of the 280-foot-long Las Vegas Strip miniature, with its accompanying six- to eight-foot-tall casino and hotel models. Dream Quest picked up where Design Setters left off, building freestanding signs, casino doors and architectural facades when production requested that more of the Strip be built after-the-fact to accommodate added shots. Backgrounds were repositioned and layered as shots were devised to create the illusion that the miniature Strip was a lot longer than it actually was. Chaser lights and even common Christmas lights were installed in each additional structure. “We knew that the major element seen on camera would be lighting,” Stuart commented. “Everything else would be kind of a wash, but we still put in enormous amounts of

detail. Street information was painted in, along with curbs, parking lots, and even tiny manhole covers that had ‘City of Las Vegas’ etched on them. Design Setters and our model shop also built various palm trees, sculpted out of foam and dressed with miniature silk fronds. Small live greens were also used to complete the foliage scheme.”

For shots of the crash-landing, the fifth-scale C-123 was flown using the same crane-and-cable rig erected earlier for the guitar sign collision. For subsequent scenes, after the plane has touched down, the model was guided and pulled along a monorail system integrated into the street.

The plane continues to careen down the Strip, with Poe and Grissom engaged in a brutal, winner-take-all fight within the fuselage. As scripted, the fight was to be interrupted when one of the propellers detaches from its housing and tears through the length of the fuselage, literally separating the men. Tasked with adding the out-of-control propeller, Dream Quest’s CG team was provided with live-action plates that featured Cage and Malkovich performing within the C-123 interior mockup. A computer generated propeller was animated to rip through the plane interior with tremendous speed and force. To complete the illusion, digital motion blur was added, along with explosive sparking effects and smoke.

For select shots, motion control photography of a fifteenth-scale C-123 was composited into live-action plates filmed on location in Las Vegas.

As the sequence literally grinds to a halt, the cargo plane tears through the lobby of the Sands Hotel, obliterating the entire front section of the famed establishment. Prior to the shoot, the production had made an arrangement with the owners of the Sands – already scheduled for demolition – to actually crash a full-size mockup of the airplane into the condemned landmark. “Once the arrangement with the Sands was made,” stated Goldberg, “we could do whatever we wanted with the hotel. Paul Lombardi and his crew built a huge rig and actually pulled the C-123 mockup into the front of the Sands, smashing everything. What was left of the mangled ‘Jailbird’ was built on a concealed bus chassis as a full-size mockup, so it could be driven right into the hotel. It was all done full-size, and it was pretty spectacular.” The doomed hotel was filmed ‘as is’ by the film crew, with the exception of an added lagoon and some superficial detailing of the hotel entrance. Several of the shots were delivered to CFC for digital cleanup. “The paint work to remove the rig pulling the plane was of a fairly difficult standard,” noted Rob Hodgson, “primarily because of the pond in front of the hotel. The rig dipped just below the surface of the water, which created a multitude of problems with recreating water reflections and ripple patterns. For many of the shots, the difficulty of the paint work was compounded by the fact that we first had to speed the shots up, which invariably left an array of artifacts that needed to be cleaned up afterward.”

Authenticity of the effects, from design to execution, had been a top priority on Con Air – one that was pleasantly affirmed for Dream Quest long before the film was submitted for audience approbation. “We were out in the airplane hangar one night,” recalled Mike Stuart, “wiring the miniature Hard Rock Hotel guitar sign. Suddenly, this brand-new Jaguar pulled right into the hangar, and I’m thinking, ‘Who is this guy?’ A man got out and introduced himself as Warwick Stone, Hard Rock’s art director and the actual designer of the sign we were replicating. Larry Albright had told him where we were and what we were doing; so he came out to the location to see. Stone was very happy with what we had done. He said that we had not only perfectly replicated the sign, down to every detail, but that we had actually captured the soul of the guitar. That was a great compliment.”

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ANACONDA
SNAKE CHARMERS

ARTICLE BY Paula Parisi

In the seventies there was the man-to-serpent shocker Sssssss, and in the eighties the viper-infested tomb of Raiders of the Lost Ark. But, generally speaking, when it comes to cinematic star turns, snakes have not fared as well as some of their beastly brethren. And with good reason. The real ones tend not to take direction, and creating a convincing fake presents formidable challenges. However, in Anaconda, a contemporary take on the classic monster genre, directed by Luis Llosa, a chilling complement of slithery costars could do for snakes what King Kong did for apes, or Ben for rats – provide them with a celluloid legacy.

Set in the Amazon rain forest, the Columbia Pictures release charts the terrifying mishaps of a documentary film crew on a river expedition that goes terribly awry. Attempting to find and photograph the Shirishama Indians, the intrepid crew – headed by anthropologist Steven Cale (Eric Stoltz), director Terri Flores (Jennifer Lopez) and cameraman Danny Rich (Ice Cube) – encounters a mysterious loner, Paul Sarone (Jon Voight), who offers to help locate the elusive tribe while neglecting to mention that he is on an Ahab-like quest for a mythical forty-foot anaconda – a mission decidedly at odds with their filmmaking objectives.

While Anaconda recruited thirty real snakes – the largest being eighteen-feet long – for a few select scenes, the bulk of serpentine screen time would be taken up with animatronic creations by Edge Innovations and XFX, and digital character animation by Sony Pictures Imageworks. “Columbia liked the script,” commented SPI visual effects supervisor John Nelson, “but they knew that the picture would need substantial visual and animatronic effects work. We had several meetings with them about how to do the project. Then Luis Llosa and Cinema Line producers Susan Ruskin and Verna Harrah viewed a character animation test we had done for Godzilla, and SPI was chosen.”

Nelson, with effects producer Aileen Timmers, began by breaking down the script and amassing a research library on anacondas. Working with the production to locate an animatronics house, they approached Edge Innovations founder Walt Conti, whose Bay Area company provided dolphins for Flipper and whales for Star Trek IV and the Free Willy pictures. Nelson, Timmers, Conti, Llosa and Ruskin worked closely early on to determine which shots would be animatronic and which would be digital. “Basically we ended up breaking them into two camps,” recalled Nelson. “Computer graphics would be used when the snakes’ full bodies were seen in motion, and for scenes where the snakes were striking, coiling or eating human prey. Everything else would be animatronic.” The show breakdown was roughly four to one, with approximately twenty-eight CGI to 110 animatronic.

For his thriller Anaconda, about an ill-fated film crew in the Amazon, director Luis Llosa turned to Walt Conti of Edge Innovations to create a pair of gigantic animatronic snakes and to Sony Pictures Imageworks for digital representations.

Preproduction on both the animatronic and digital fronts was launched approximately seven months prior to the start of principal photography. Conti and his Edge Innovations team commenced by developing design concepts for the two giant anacondas featured in the story. Described as perfect killing machines, anacondas are the largest breed of predatory snake in the world. Reigning at the top of the food chain in their native Amazon, they feed on antelope, boars and other large animals, dispatching their prey with a bone-crushing stranglehold before swallowing it whole. In the script, the larger of the two snakes – the Queen, featured only in the climactic end sequence – was depicted as having an eight-foot girth and a head roughly the size of a desk. “You could see they were thinking a monster type of thing,” Conti observed, “so one of the first things we did was build about a dozen foam mockups in a range of sizes, from the absurdly large snake referenced in the script to something more realistic. As soon as the filmmakers saw them, they realized that what they really wanted was a snake that was plausible, but maybe a little bit larger than what people might expect.” Conti wound up constructing the Queen as a forty-foot-long model, and a smaller male snake – the Warrior – as a twenty-five-foot model. Both sizes were within the realm of possibility for real anacondas. While the longest on record measured thirty-seven feet, anacondas continue growing until they die, so it is quite possible that larger ones exist, undocumented, in the depths of the jungle.

Once the size issue was settled, the next consideration was finding an appropriate look for the snakes. As reference, Conti and crew extensively photographed a sixteen-foot anaconda named Annie at a pet store in Culver City, then created maquettes that were physically, though not physiognomically correct. “It became very clear that an anaconda, if you look at it without its markings, is actually kind of cute,” Conti said. “They’re water snakes and have big, bulbous eyes that allow them to see over the water; so they look kind of like E.T.” Since cute was not what the filmmakers had in mind, Conti devised a countenance for the models that incorporated the more threatening features of a viper and a rattlesnake, while still preserving the integrity of the anaconda.

A second unit crew prepares to shoot one of the puppet anacondas.

Having secured approvals on the designs from Llosa and the producers, Conti proceeded to construct the models. Sculpting supervisor Jonathan Horton and key sculptor Stephanie Englert began by creating a clay version, used as the basis for molds from which the skins would be cast in urethane. With 60,000 scales on each snake requiring individual sculpting, the chore would take twenty people a month and a half to complete. Created in two halves, front and back, the skins were designed – under the supervision of Dave Caldwell – so that each side could be pulled onto the mechanism like a sock. With guidance from Marta Fuentealba and Wilson Kwok, modelmakers coated the completed skins with a urethane paint, green and yellow for the Warrior – patterned precisely on Annie – and a more regal reddish brown for the Queen. To duplicate the translucent sheen of a real anaconda, the skins were painted on the inside rather than the outside.

At the location base camp for Edge Innovations, Conti and crew test the hydraulic device used to actuate the snakes.

With few features to allow it expression, the anaconda’s eyes and tongue became a focal point for the modelmakers. “The slightest change in the eyes had a tremendous effect on how the models were perceived,” Conti commented, “so we made dozens and dozens of eyes with different colorings and patterns, and tested them on dummy heads with extensive still photography.” Hand-painted in acrylic, the final eye treatments benefited from a bit of creative

license. “By combining several types of reptilian eyes, we made them stand out a little more than a real anaconda’s, which tend to blend into the face. We also introduced metallic color to them so that they had some bounce, like a cat’s eyes. When light reflected off of them, it created a little glimmer that a real snake’s eyes wouldn’t have – which resulted in a more sinister look.”

Though physical characteristics were impor-tant, equally critical were the design and execution of the mechanics used to effect convincing movement in the replicas. “If you think about it,” Conti noted, “a snake doesn’t have any facial expressions or eyebrows or sneers. In fact, it doesn’t have any human-based characteristics. The personality of a snake is entirely based in motion. We knew if we didn’t get the movement right, nothing about it would look real.” Having built simple animatronic snakes for the movie Maverick, Conti’s team had some experience in the ophidian realm. However, prior to embarking on the much more elaborate anacondas, mechanical designers Joss Geiduschek, Tony Lawson, Tom Hsiu and Steve Blumenkrantz studied snake skeletons and vertebrae for additional clues. The long, sinuous nature of the reptiles posed difficulties in terms of creating and housing the internal mechanisms. Consequently, custom-built parts were needed, rather than off-the-shelf ware – which complicated the task considerably. Adding to the difficulty was the type of movement required. “The unusual thing about snakes is that they move very slowly, but are also capable of quick, unpredictable bursts of speed. That contrast of motion is a very challenging thing to accomplish with animatronics. It’s easy to do something that moves fast and it’s easy to do something that moves slowly and smoothly. But it’s hard to create something that does both.”

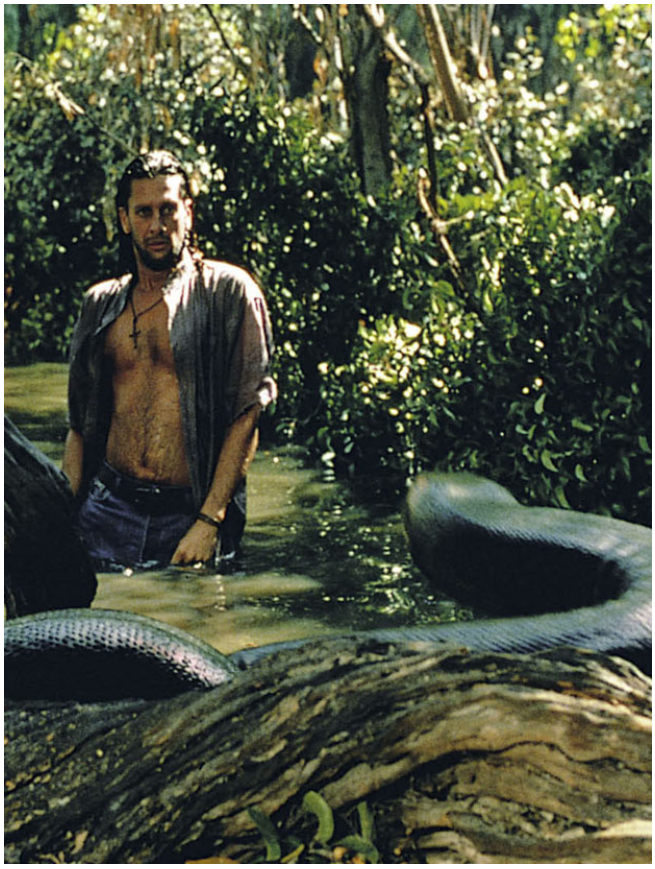
To emulate the complex undulating moves characteristic of real snakes, Conti equipped both the Warrior and Queen with 140 joints, fitted into each body along with forty miles of wiring. Powering the huge constructs – which weighed in at 1500 and 3000 pounds respectively – were 250-horsepower hydraulics

. “That’s the equivalent of a Porsche or two Honda Accords,” quipped Conti. Performances were orchestrated via a customized computer control system, designed by Ty Boyce, Alan Schier and Alan Cooney. “With 140 joints squeezed into a long, slender space, how do you control them? The typical way to articulate would have been to have a bunch of people operating waldos or joysticks. But that couldn’t work in this instance because we would have needed about thirty people to control that many joints. Thirty puppeteers would have made it impossible to get the movements coordinated.” The computer sys-tem – which drew on the processing strength of a powerful array, equivalent to 300 Pentium Pro PCs – was capable of functioning in two modes of operation. In its shooting mode, it could control each individual joint during filming, instructing it to go right or left, up or down. In its programming mode, special software, designed by John Williams, enabled the effects team to plan the snake’s performance in advance, programming in moves that could be played back later on the set. “At night, we would discuss upcoming shots and program the next day’s body motions using the software.”

For live-action scenes with the effects snakes – filmed at the Los Angeles Arboretum in Arcadia – Conti and his team set up their elaborate programming system in a trailer. Although its capabilities proved invaluable in planning the intricate moves required by the script, provisions were also made for on-the-spot fine-tuning of the snake performances. “On the set, everything is

dynamic," remarked Conti. "What you don't want is a system where you just push a button and it plays the same movement again and again. Though we would record the moves of our snake in advance – to keep from having to control and coordinate every single joint during the shoot – puppeteers on set would still control the overall timing and pacing of the moves. Using a dial control knob, they could make the snake go slower or faster, forward or back – which enabled us to better match the animation to the dynamics of the scene." Puppeteers on the set also employed joysticks to command the head and neck, eye and mouth movements – helping to finesse believable interaction between the model snakes and the actors. "It was a hybrid computer-puppeteering system."

Filming of the models was complicated by the fact that, for every scene, the mechanical snakes needed to be secured to anchor points, or ‘pick points,’ throughout the set. “When we moved the snake’s head at maximum speed – forty to fifty miles per hour – it had a torque of five tons,” said Conti. “It had to be mounted to something very, very solid, or the whole thing would shake. And we knew that these mount points would have to be designed and built so that we could move our puppets from point to point and mount them in the different areas of the set. We ended up with twenty-two distinct places where we mounted them. Some were underwater, some were in a waterfall, some were on a barge. There was a huge variety of locations – and for each, we had to design and build big concrete foundations where the snakes could be affixed.”



Boat pilot Mateo (Vincent Castellanos) suffers a fatal attack. Scenes requiring the anacondas to move or coil quickly were accomplished by the

Sony Pictures Imageworks team using computer generated snakes.

In an abandoned mill, the Queen anaconda – a CG version animated by SPI – descends upon two members of the hapless film crew.

Anchored at the midsection – at the point where the skin was seamed – each animatronic anaconda could move freely, but only from the pick point forward or back. Although incapable of the kind of full body motion that might enable it to slither across the set, clever camerawork made it appear to do so. “Even with that solid mount point, the snake could traverse a lot of ground,” Conti explained. “We could bring the head back twenty feet, behind the mount point, then make it lunge forward that twenty feet plus an additional twenty feet. Creative framing gave the impression that the snake was traveling.”

Keeping the enormous animatronics function- al during filming of Anaconda’s live-action scenes was a grueling twenty-four-hour-a-day operation for Conti and company. “We’d shoot with a snake in one spot all day. Then at night we’d come in, unhook it, crane it to a new location, and hook it back up in preparation for the next day’s filming. It was the opposite of Jurassic Park, where the hydraulically powered T-rex was mostly shot on one or two sets that were redressed to accommodate it. On Anaconda, we were moving every night.” Fortunately for the animatronics crew, the producers scrapped earlier plans to have the snakes shipped to the Brazilian Amazon, where the first half of the film was shot, opting instead for the more controllable and considerably tamer local site.

To supplement the Warrior and Queen anacon-das provided by Edge Innovations, other snakes and some prosthetic death gags were contributed by a team of forty artists at XFX, working under the supervision of company founder Steve Johnson, mechanical supervisor Eric Fiedler and mechanical designer Bob Newton. Among the 120 snakes provided were eight animatronic crawlers, eight wrigglers and 100 silicone snakes ranging in size from eight to twelve inches, some of which could be marionetted via monofilament.

Among the smallest of the animatronic constructs was a detailed seven-inch snake, sculpted by Nori Honda, for a scene in which a baby anaconda bites off the finger of documentary narrator Warren Westridge (Jonathan Hyde). Equipped with cable-operated wriggle and flex movements, the puppet featured a mouth that could be opened extra wide and shut via a rod which was later removed digitally in postproduction. The largest mechanical – a five-foot-long cable-operated puppet – was designed to drop onto production manager Denise Kalberg (Kari Wuhrer) during an attack scene shot at the arboretum. Additional XFX effects included a forty-foot-long snakeskin fabricated by cosmetic designer Bill Bryan, several silicone capuchin monkeys, a tiny mechanical puppet wasp for a scene in which Cale chokes on the poisonous insect, and a number of articulated dummy likenesses of performers for scenes in which their characters fall prey to the deadly anacondas.

Though prosthetics and dummy snake coils were useful for closeup views of the snake attacks, complex interactions between the anacondas and their victims would necessitate a digital solution. Designing computer generated snakes that could strike, coil, eat and regurgitate principal characters presented unique challenges for the Sony Pictures Imageworks digital team, which included – with John Nelson – animation director Eric Armstrong, CG supervisor John McLaughlin and visual effects producer Robin Griffin.

Concurrent with the animatronic development at Edge Innovations, SPI was busy defining the actions for each of the snake attacks, and the technical pipeline to realize them digitally. “Luis wanted each of the strikes to be different,” stated Nelson. “Having viewed thirty or forty snake feedings, we were pretty locked in on what the real snake would do. The strike of a real anaconda is incredibly fast and intricate. The snake completely overwhelms and engulfs its prey in a single action that takes little more than half a second.” Working with storyboards, GI Joe dolls and a video camera, digital artists defined the actions of the main strikes us-ing 3-D Studio on PCs and Alias running on an SGI. Attendant requirements for the shots – such as stunts, rigs and cameras – were determined based on those previsualizations.

Since off-the-shelf software would not be sufficient to realize the character animation, custom software also had to be developed. “We had two primary areas of concern,” observed Nelson, who with Griffin prepared for the plate shoot and oversaw the postproduction pipeline issues. “One was performance of the snake and the other was its photorealistic quality. Eric Armstrong worked on the modeling and animation part of the pipeline, while John McLaughlin set up the directory file organization, texture and scale applications and RenderMan lighting and rendering issues.”

Taking their lead from the animatronic designs, modelers began the task of creating digital anacondas by scanning Walt Conti’s maquettes into the computer to use as checkpoints. Lead modeler Kevin Hudson then relied on blueprints, also provided by Conti, to guide him in constructing a wire-frame replica. “Walt gave us about a dozen cross-sections along the length of the snake,” recalled McLaughlin. “Kevin digitized each of them, then interpolated extra cross-sections in-between – ending up with about 250 for the larger of the two snakes.” Laid end to end, these circular sections comprised the essence of the digital model.

To animate the wire-frame for scenes in which the snakes attacked their human prey, digital artists had to duplicate the live-action plate photography, shot for shot, in the computer. Match-movers, led by Michael Harbour, duplicated camera moves and angles, while McLaughlin and his team created digital versions of the set and its contents. “A lot of the CG we do is never seen by the audience,” said McLaughlin. “To do the work, animators need a 3-D background – but live-action is only 2-D. So what we have to do is model the three-dimensional environment in the 2-D plate. In the case of Anaconda, that included not only the sets, but also the actors and any objects the CG snakes needed to interact with. When everything was completed, we rendered the snake and pasted it over the original live-action – and all that extra CG we had to model was just thrown away.”

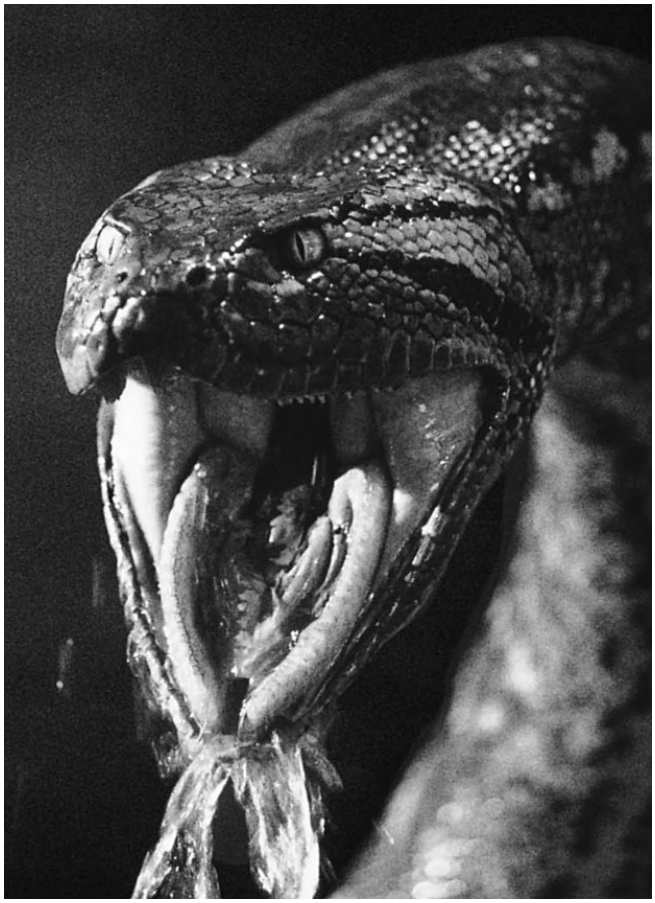
Animation was divided into primary and secondary elements. “Primary animation was done along a single spline path,” explained Armstrong. “The idea was that the snake is kind of like a

rope, long and skinny, so we approximated its movements as if it were a rope attacking a human." Proprietary software, called Map Snake, written by Bruce Navsky, enabled the animators to link their CG snake with the rope movements. "First we animated the head of the snake, then the body along this line – with Map Snake used to attach the body to the line. That process went back and forth in refinement until we had a snake attached to a human in a believable way." Secondary animation consisted of muscle movement and sinuous rippling down the body of the snake. Forty-two vertices, contained in each of the cross-sections making up the wire-frame, provided a high degree of control over secondary moves. "The animators would select a small number of key cross-sections along the length of the snake, and only animate those sections. Map Snake would then interpolate that animation to the rest of the cross-sections – which meant we didn't have to hand-animate the entire snake."

Once realistic animation was locked in, shots were handed off to a color and lighting team which rendered the models with surface details, texture-mapping and lighting effects. "Since our digital snakes had to look like Walt Conti's models," noted McLaughlin, "our texture painter, Raquel Morales, matched their markings and colorings." However, unlike the animatronics team – which had to individually sculpt thousands of scales on the practical model – the digital team relied on procedural displacement shaders, developed by Serge Sretschinsky and Jim Berney, to achieve the scale effect in RenderMan. After the snake was rendered, digital artists relayed each shot to effects animators Jason Dowdeswell, Michael Travers and Michael Harbour. Using particle systems and Elastic Reality morphs, they generated environmental elements – such as dust and leaves – for the snake to interact with as it moved through frame. After considerable fine-tuning, final renders were passed on to a compositing team, lead by Colin Campbell, for insertion into the live-action backgrounds.

Edge mechanical designers Ted Rogers and Joss Geiduschek field-check the complex snake mechanism between shots.

One particularly complicated scene featured a combination of on-set stunt work and postproduction CG effects. Set near a waterfall, the sequence depicts a surprise anaconda attack on Westridge, who tumbles over the falls, only to be snatched in mid-drop by the uncoiling snake. As with all the scenes involving CG, the waterfall sequence was carefully previsualized. "Originally, we started our previz on 3-D Studio," recalled Nelson "but then we decided that we wanted to work out the actual animation pipeline, so we switched to the SGI platform and Alias software." Animators created a digital representation of the actor in the scene in order to map out the action. "We put him through the actions we thought were necessary to make the shot effective, based on the director's notes and the original storyboards. Then we showed it to Luis for feedback and eventually came to a consensus about what the shot would be like."



To make the anaconda look more threatening, subtle modifications were made to the face.

On set, the previsualized action was replicated by a stuntman – under the guidance of stunt coordinator Webster Whinery – who performed an acrobatic plunge off the waterfall with the aid of an accelerator-decelerator rig. “Basically the stunt called for him to jump off the waterfall, decelerate to a stop, then accelerate back up. On the way up, he had to pull a ripcord that started him spinning and twisting. It was amazing that Webster’s crew came up with that, and even more amazing that it worked.” Once the plate photography was achieved, it was up to SPI to remove any signs of the stunt rigging and animate the CG snake to fit the stuntman’s action. Animated by Kelvin Lee, it was one of the most difficult shots tackled by the digital team. “That shot is a good example of how we used CGI to define a difficult action,” observed Nelson, “working with stunts and camera to accomplish the real elements on film during plate photography, and then animating the digital character to fit those elements.”

A number of smaller snakes and some animatronic attack victims were constructed by XFX.

As complex as the waterfall sequence was, it was not SPI’s biggest challenge. That would come later in the film, when the hapless crew stumbles into the Queen’s lair – an old, abandoned mill now home to hundreds of baby anacondas, represented by live snakes. A chase ensues, with Sarone setting Terri and Danny up as snake bait for the Queen. Before long, however, the tables are turned and the hunter becomes the hunted.

Pursued by the Queen, Sarone is struck, yanked up and backwards, and dragged along the floor on his belly. The scene was filmed in two parts. First, Jon Voight was shot scrambling across the floor to the point where the snake hits him. Then a stuntman, doubling for Voight, was photographed being pulled back forcefully by an overhead flying rig devised by Whinery and Dennis Scott. That image – minus rig and landing pad – was composited into a clean plate of the background. A morph was used to smooth the transition between Voight and the stuntman; and a CG snake, animated by David Vallone and tech-directed by Liza Keith, was added. “This shot required many custom adjustments,” stated Nelson, “as the twists of the snake’s body were extreme and seen in slow motion.”

Moments later, the anaconda consumes its nemesis in a gruesome scene animated by Manny Wong. The CG snake – altered in shapes as its prey is swallowed whole – was composited into live-action footage of a still-kicking Sarone. An interior view as Sarone is ingested was accomplished as a practical gag – orchestrated by Joel Harlow and Lennie MacDonald of XFX – with an eight-foot tube of vinyl used to simulate the anaconda’s interior gullet wall. Articulation

was supplied by cable-lined hoops that could shrink and expand, placed at intervals along the gullet, which was suspended hammock-like on a speed-rail frame. The final effect was achieved by sliming up the performer and sliding him into the anaconda's mouth on a teeter-totter, rolled forward on a track while external puppeteers manipulated the gullet and constricting rings.

In the action finale, the Queen chases Terri up a smokestack. Exploded fuel drums ignite the snake, which emerges burning from the top of the stack, then falls through the air into the river, where it thrashes in death throes. The snake was animated by Rodney Iwashina, with the smoke, fire and water elements created as particle effects using Dynamation software. "It was the longest of the CG snake shots," McLaughlin noted, "but not our most difficult because there was no interaction with humans. Also, it was further away and somewhat more forgiving because the snake was on fire. Our biggest task was to make the fire look real."

For Edge Innovations, XFX and Sony Pictures Imageworks, bringing Anaconda to life was a complex exercise in teamwork and coordination. "To be able to accomplish action scenes this difficult required a tremendous amount of planning, attention to detail and hard work on the part of an extremely talented pool of animatronics specialists, puppeteers, animators, technical directors and digital artists," asserted John Nelson. "It was a team effort all the way."

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ON THE SHOULDERS OF GIANTS

image

ARTICLE BY Jody Duncan

Even a cursory review of film- or effects-related books and articles published in the past four years gives testament to the significance of Steven Spielberg's Jurassic Park, a film that was immediately heralded as the high-water mark in digital effects achievement upon its release in 1993. Riddled with phrases such as 'before Jurassic Park' and 'since Jurassic Park,' such writings confirm the movie's preeminent position in the short history of computer animation. Its highly regarded standing within the effects industry, coupled with worldwide popularity and spectacular performance at the boxoffice, made Jurassic Park a tough act to follow. But that did not stop Steven Spielberg from embracing the prospect of making a sequel, The Lost World, when novelist Michael Crichton wrote the best-selling follow-up to his original story.

After an extended hiatus, Steven Spielberg made a return to directing with The Lost World, the follow- up to his 1993 blockbuster, Jurassic Park. To realize the production's wide variety of dinosaurs – many of them new to the sequel – Spielberg once again relied on the animatronic expertise of Stan Winston Studio, interactive gags supplied by physical effects supervisor Michael Lantieri, and the digital wizardry of Dennis Muren and Industrial Light & Magic. Spielberg directs the performance of a mechanical baby stegosaurus on location near Eureka, California.

Like Jurassic Park, The Lost World – as conceived by Spielberg and screenwriter David Koepp – would differ somewhat from the story Crichton had penned. But core narrative points remained. To save the declining bioengineering company from bankruptcy, executives at InGen send an expedition of game hunters to a second Costa Rican island, rumored to be a habitat for dinosaurs that survived the Jurassic Park debacle four years earlier. The hunters' mission is to round up herbivore species and return them to California, where 'Jurassic Park - San Diego' – a prehistoric theme park – is under construction. Looking to save both his reputation and the thriving island wildlife, an ailing John Hammond (Lord Richard Attenborough) sends a small expedition of his own, guided by Ian Malcolm (Jeff

The movie opens on Isla Sorna, a deserted island off the coast of Costa Rica, where a vacationing

Goldblum), the eccentric mathematician who barely escaped with his life the last time he went head-to-head with the dinosaurs.

Although he envisioned a bigger and bolder film, Spielberg approached the sequel much as he had Jurassic Park, laying out detailed storyboards and conceptual artwork with a small art department at Amblin Entertainment a full year before the start of production, and two years before Universal Pictures released the movie in May 1997.

Spielberg also assembled a creative team that was, with very few exceptions, the same one that had brought Jurassic Park to fruition. Reinstituting the three-pronged effects approach that had been so successful in the first film, Spielberg engaged Stan Winston Studio, visual effects supervisor Dennis Muren of Industrial Light & Magic, and physical effects supervisor Michael Lantieri, the triad that had collaborated to realize the stunning dinosaurs for Jurassic Park. Winston had fabricated full-size mechanical creations for closeup and interactive shots; Muren and the ILM crew – in concert with animation supervisor Phil Tippett and his team – had animated three-dimensional, computer generated dinosaurs for dynamic full-motion shots; and Lantieri had supported both the live-action and digital efforts, mounting the enormous Winston rigs on stage and engineering practical gags to create the illusion of the CG dinosaurs' presence on the set.

For the effects collaborators, The Lost World represented a return to well-trod territory – yet neither Lantieri, Winston nor Muren looked upon the sequel as an invitation to rest on laurels. In fact, the scope of the new film demanded that all three reach beyond their technical and artistic grasps, just as they had for the original movie. "From a special effects standpoint," Lantieri remarked, "The Lost World was at least double any normal movie project. You could take any two movies I've done – including Jurassic Park – and this show was as big or bigger than those two put together. I had to add six people to my regular crew of twelve just to begin to accommodate the size of this project." For Lantieri, the demands of the show included the nightmarish logistics of rigging a multi-ton trailer to look as if it were being rammed by a Tyrannosaurus rex, dragged toward the edge of a cliff and finally pushed over the drop. Other effects sequences featured fires raging through a campsite and vehicles being ripped apart and catapulted into the air. In the film's climax, buses would be rigged to tip and implode as if impacted, street signs would topple and storefronts would be demolished, all through special effects ingenuity. In addition to such 'spectacle' effects, Lantieri's assignment would include the building of customized vehicles and equipment, plus the development and execution of interactive gags to effectively place the CG dinosaurs into location and stage environments. Lantieri would even be called upon to delve into matters agricultural, growing eight acres of five-foot-tall elephant grass for one of the movie's key sequences.

Stan Winston too, would be called upon to best himself for The Lost World, which – with baby dinosaurs thrown into the mix – would feature thirteen different varieties of animals, as opposed to Jurassic Park's seven. Of those thirteen, seven were entirely new characters that would have to be designed by the artists at Stan Winston Studio. Six would also be constructed as fully functional animatronic creations. With returning characters such as the velociraptor

young girl befriends a seemingly benign compsognathus. For the opening scene, Stan Winston Studio designed and constructed a 'compy' puppet, articulated through rods, marionette techniques, servos and pneumatics.

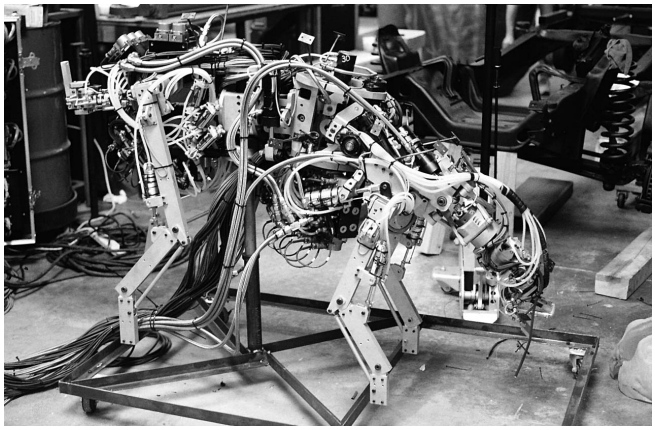
Mechanical designers Chris Cowan and Jon Dawe test a pair of radio-controlled compys engineered and built for a later sequence.

and the T-rex, the Winston slate of dinosaurs totaled nine, some demanding multiple mechanical versions or fresh designs.

For Winston, the challenge of the new assignment was magnified by a sense of responsibility to both Spielberg and the audience to deliver even more than he had for Jurassic Park. “I definitely felt the pressure to do a better job on this movie than we had done on the first one,” Winston remarked. “I always feel the pressure to do something new, something dramatic, something exciting. But the pressure on this show was more intense, just by virtue of the fact that this was a bigger picture, with greater challenges. And it came in the wake of Jurassic Park, which was not only the biggest thing we’d ever done, but had also prompted the most enthusiastic response this type of film had ever seen. To top that was a huge responsibility.”

Brought onto the project a full year before filming would begin, Winston and his studio artists and technicians began with the design of six new dinosaur characters the shop would be building – the chicken-sized compsognathus, an adult and a baby stegosaurus, the goatlike pachycephalosaurus, a pteranodon and a baby T-rex – as well as the design of the mamenchisaurus, a new species that would be realized only in CG. Returning species such as the T-rex, velociraptor, triceratops and parasaurolophus – all of which the Winston studio had already designed and/or built for Jurassic Park – did not require from-scratch concepts; but some updated design and color scheme work was needed since, unlike the first film, The Lost World would be populated with both male and female animals.

Once a behind-the-scenes site for InGen’s feats of genetic engineering, Isla Sorna has become a habitat for the surviving dinosaurs and their naturally bred offspring. Early in the film, Ian Malcolm and a small expeditionary party – sent to document the animals’ existence on the remote island – encounter a herd of stegosaurs. Scenes with a baby stegosaurus utilized a full-size mechanical puppet, created by Stan Winston Studio. Studio artists sculpt the infant dinosaur in clay.



A hydraulic- and servo-controlled armature was constructed for the baby. The advanced, computer-linked telemetry control system – developed for the original film’s Tyrannosaurus rex – was upgraded and applied to nearly all of the sequel’s mechanical dinosaurs.

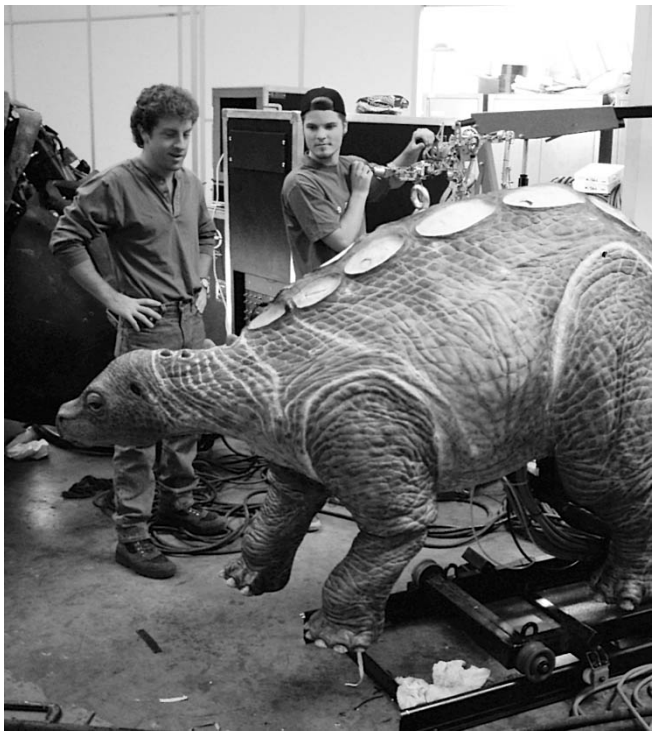
Key artist Dave Grasso and Christian Lau fit body shell sections over the completed armature.

Concept sketches of the new characters – rendered by Crash McCreery, Joey Orosco and Rion Vernon – evolved into detailed maquettes sculpted by studio artists, then painted.

With Spielberg's approval of the maquettes, the Winston crew began the construction portion of the project. Full-size sculptures were fashioned for the six new characters, along with new molds, fabricated muscle structures and mechanical armatures. Returning characters that had been sculpted and molded in full scale for the first film – such as the T-rex and the raptor – did not have to be resculpted, but new foam latex skins, new musculature fabrications and major retrofits of the original armatures were required.

Grasso adds cosmetic detail to the foam latex skin covering the baby.

Characters old and new were mechanized to take advantage of advances in hydraulic, servo and electronics technologies, and to reap the benefits of lessons learned on the original film. For Jurassic Park, Winston had plunged into the realm of large-scale hydraulics to realize the animatronic performance of the thirty-five-foot-long, ten-thousand-pound live-action Tyrannosaurus rex – a character far too big to articulate via standard cable or radio control techniques. The leap had required consult with hydraulics engineers from the world of theme park attractions, as well as time-consuming in-house education. But the results had been worth the trouble when the T-rex – which Winston had assumed would be the most problematic of the characters – performed flawlessly and with relative ease.



Employing the telemetry armature, electronics designer Glenn Derry demonstrates movement capabilities of the nearly finished puppet for Grasso.

The smoothness and overall high quality of the T-rex performance convinced Winston that all of The Lost World's animatronic characters – with the exception of the compys – should be mechanized in a similar fashion. Hydraulic mechanisms designed by Tim Nordella and Lloyd Ball were computer-linked to a telemetry device – a small-scale replica of the full-size armature – that could be manipulated by a small puppeteering team. "Each character had a telemetry device," said mechanical department coordinator Alan Scott,

“which represented in miniature the mechanical features of the full-size puppet. When we moved this device, it electronically translated that movement through the computer to the hydraulic puppet, which would make the same move, in real time.”

While the Winston Studio mechanical and electronics departments concentrated on the engineering of the control systems, a moldmaking team of eighteen – headed by Joe Reader, Barry Crane and Tony McCray – fashioned molds from full-size sculptures, using the same aerospace epoxies that had been in-troduced on Jurassic Park. “We did some new things in the way we molded these characters,” noted creature effects supervisor John Rosengrant, “based on what we had learned last time. In general, we made the skins a little thinner so that they would hang and fold more like real skin. Then, to support the skin, we went inside and built up fabricated musculature that went over the mechanics. So, instead of having an armature covered by a thick foam latex skin, the armature was surrounded by these simulated muscles, with a thinner skin going over that.” Even returning characters were modified to accommodate the new approach. “The raptors we built for Jurassic Park had a fiberglass shell underneath the skin. For this show, we cut back that fiberglass shell, leaving it only in areas where there would naturally be bone structure. Then we filled in those cutaway areas with fabricated muscle structure.”

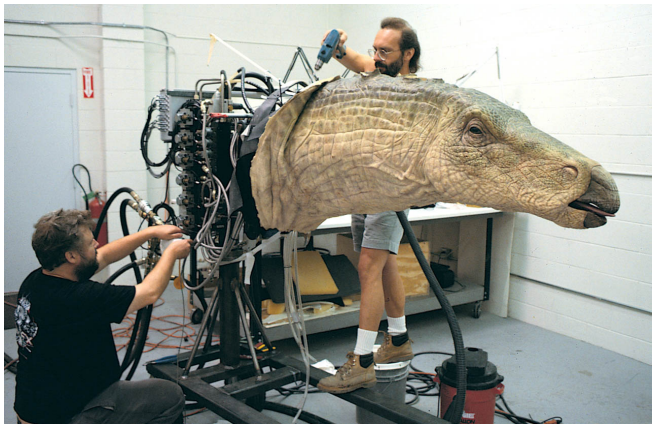
Paleontologist Sarah Harding (Julianne Moore) attempts to photograph the infant stegosaurus. Transported to a state park in the Eureka region, the four-hundred-pound puppet was securely mounted near a stream and puppeteered from off-camera.

The fabrication department was charged with creating that underlying musculature for each character. “It was our job to make the mechanical movement of the armature translate into what looked like actual muscle movement in a living creature,” explained department head Karen Mason. “We used a variety of foams, elastics, spandex and other fabrics to simulate that musculature. Then we put the foam skin on top of that, using various sewing techniques to finish the outer look of the dino-saur.” Approximately three hundred gallons of foam latex were run to produce all of the dinosaur skins, a task executed under the direction of John Calpin and assistant Lance Gilmer.

Demanding the design and construction of both new characters and new mechanical control systems, The Lost World assignment was not just a matter of reapplying what had been already developed for the first film. “Some would say there was a lot of learning we had to do for the first movie that we didn’t have to do for this one,” Winston said, “but I refuse to say that. Jurassic Park was a tremendous learning experience; and this movie would have been a lot easier if we’d just repeated everything we’d done the first time around. But we didn’t do that. We didn’t even come close to doing that. In fact, there was not one dinosaur in The Lost World that was built or operated exactly the way it was for the first movie. We took whatever worked on the first movie a step further and improved it. So there was another learning curve for this movie in that we advanced the art of animatronics just that much more.”

Advancement was also very much on Dennis Muren’s mind when he accepted the computer animation assignment for The Lost World. Determined to best ILM’s much-heralded work for Jurassic Park, Muren pushed the slate of full-motion dinosaur effects into something far more challenging than a ‘been there, done that’ affair. “At the beginning,” Muren remarked, “people

Also transported to location was a full-size adult stegosaurus, built for a scene in which the herd’s alpha male launches an attack on Sarah. Kirk Skodis mounts tail spikes onto the twenty-six-foot-long creation.



Technician Bruce Stark adjusts electronic fittings as mold department coordinator Joe Reader applies the outer skin to the giant puppet.

would say to me: ‘Why do you want to do this sequel? You’ve already done this – why would you want to do it again? How could you possibly do it any better?’ Well, to me, figuring out how to do it better was exactly the point. We knew we could make the animals look more real, for example – even if not jarringly more real. The leap from stop-motion to the CG in Jurassic Park was much bigger than the leap from Jurassic Park to the CG in The Lost World. And there was no way around that. But the goal was to make it so much better that people would still be amazed – just as they were in the first film.”

Key artist Mark Maitre attends to the stegosaurus on location. To streamline production costs, only the head-and-neck and hindquarter-to-tail sections of the stegosaurus were constructed. Careful framing of shots disguised The Missing midsection.

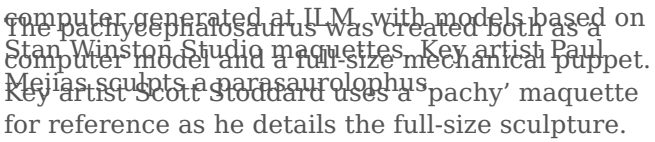
One way in which Muren upped the ante in terms of the sequel’s effects was to encourage Steven Spielberg to design CG shots that were more interactive, more dynamic and more bold than what had been possible for Jurassic Park, when 3-D animation was still in its infancy. “When we began working on Jurassic Park,” Muren noted, “we didn’t even know if we could create photorealistic animals through CG; and we didn’t want to go so far out on a limb that it would be a disaster. So we were conservative when it came to shot designs and camera movement. By the end of that show, I started getting a little bolder with the camera moves and getting tighter on the animals – but the constraints of CG still made it seem as if I was working with one hand tied behind my back. This time out, we knew we could do the work; so our energies went into the shot designs and the actions of the characters, rather than just figuring out how to get those characters on the screen to begin with. We wanted to come up with shots that had nuance and boldness, treating the CG dinosaurs as if they were absolutely real and we were really shooting them in the wilderness. It took the first show and our work in the four years since to fully understand the freedom that CG allows; and we used that incredible freedom in conceptualizing these sequences.”

Although the mechanical stegosaurus was featured later in the film, ultimately, all of the initial herd and attack shots were realized through computer animation. Maquettes produced at Stan Winston Studio were sent to ILM, then scanned to provide a basis for CG models. ILManimation director Randal Dutra adds color refinements to the adult stegosaur.

The stegosaurus encounter is followed by a scene in which game hunters, sent by InGen, arrive on The Island and proceed to round up dozens of herbivores for transport back to the United States. Due to the dynamic nature of the sequence, animals such as parasaurolophuses, gallimimuses, mamenchisaurs and pachycephalosaurs were

Early in 1996, shots were being designed both in the Amblin art department and at ILM, where effects art director George Hull began to render concept art for the show. “It was a fantastic stage

of the process," observed Hull, "early enough to have some input. At that stage, there wasn't a final script yet, and we hadn't received many of the production storyboards, so I had the opportunity to think of ideas very freely. Steven Spielberg was working with his own team of artists, but he also seemed open to ideas coming out of ILM."



The pachycephalosaurus was created both as a computer model and a full-size mechanical puppet. Key artist Scott Stoddard uses a 'pachy' maquette for reference as he details the full-size sculpture.

computer generated at ILM, with models based on Stan Winston Studio maquettes. Key artist Paul Mejias sculpts a parasaurolophus.

Hull created preliminary storyboards for every visual effects sequence in the film, which were adjusted and refined once the actual location plates began to arrive. "Inevitably," noted Hull, "the shots wound up being somewhat different than what had been boarded. So, after the plates started to come in, I drew more specific boards, tying them to landmarks in the plates. I would take frames from the filmed backgrounds, scan them into the computer, and then digitally combine them with hand drawings of very specific creature action. They were storyboards, but they were much more precisely integrated with the real live-action backgrounds."

As one challenging sequence after another was conceived and added to the schedule, Muren and visual effects producer Ned Gorman began to assemble the animators and technical directors who would bring those sequences to cinematic life. Recognizing that the dinosaur animation in The Lost World would require not only technical expertise, but also the keen eye of an animator who understood animal behavior and the nuances of performance, Muren enlisted animation director Randal Dutra, a stop-motion veteran who, as senior animator on Jurassic Park, had been responsible for much of that film's hands-on animation. "The danger with computer animation is that anyone who can access animation software can make anything move," noted Dutra. "But the question is, does it move with any understanding or knowledge? Just being able to move something doesn't make you an animator. The creative choices are everything; and the ability to make the best choices is the art of animation."

Working closely with Muren and Dutra were lead animators Dan Taylor, Miguel Fuertes, Doug Smith and Daniel Jeannette – who, collectively, supervised a team of twenty-six animators. CG supervisors Kevin Rafferty and Euan Macdonald led the efforts of sequence supervisors Erik Mattson and Ben Snow, and more than twenty technical directors, to integrate CG elements into the live-action. As early as May 1996 – nearly four months before the start of principal photography – all of the supervising animators and technical directors began to join Muren and Gorman in meetings intended to work out a game plan for The Lost World. "We started going over the storyboards one at a time," recalled Kevin Rafferty, "estimating how long a time we would need for the show, how many TDs and animators would be required, what new capabilities we would have to develop, et cetera. As we went through the storyboards, we were all saying: 'My God, this is way over the top. This is going to be amazing.' Just looking at the grand nature of the shots and the high volume of creatures in them made an impression on us in terms of how big a thing we were getting ourselves into."

What the ILM artists and technicians had 'gotten themselves into' was a film that demanded more in terms of design, complexity and sheer volume of shots than had the original. For Jurassic Park, ILM had been responsible for only thirty-six CG shots, with Phil Tippett's team animating another sixteen or so. ILM would produce more than double that number for the sequel. "We had ninety-one 3-D shots," stated Ned Gorman, "and, of those, about eighty were

dinosaur shots, with the remainder being 3-D shots of CG vehicles and trailers. On top of that, we had a hundred 2-D shots, including wire and rod removals. In fact, in and of itself, the 2-D work for this show would have amounted to the work on a good, medium-sized movie – but then we had the little matter of dinosaurs to deal with on top of that. It was a very big show, and the schedule was incredibly tight." Because of the size of the show, the digital effects load was ultimately divided, with 2-D and model photography shots given over to associate visual effects supervisor Rick Schulze, freeing Dennis Muren to concentrate primarily on the 3-D dinosaur effects.

Path scripts that laid down a predetermined course for each animal, coupled with automated walk and run cycles, expedited animation for roundup scenes involving large numbers of dinosaurs.

During live-action filming of the roundup, visual effects supervisor Dennis Muren used dinosaur maquettes to estimate shot composition. Muren and a small crew from ILM were present on location throughout the main unit shoot to oversee the filming of background plates for the full-motion dinosaur shots.

Not only was the volume of work greater than in Jurassic Park, and the schedule tighter, many of the effects shots, as designed, were complicated by wild camera moves, high frame counts, extremely tight closeups, or the inclusion of multiple, interacting dinosaurs. “We had a number of shots with two or more animals in them,” related Muren, “and several with entire herds. The multiple creature shots were much more difficult, if for no other reason than it meant we had two or three or four animals to animate in a scene, rather than just one. The animation for each one of those animals had to look as real and as detailed as that in any one-character shot. There were no shortcuts. And if the animals interacted with each other in a scene, it was that much harder.”

In the course of the roundup, hunters on motorcycles chase their prey around and through the legs of the giant, lumbering mamenchisaurs. Determined to aim beyond what had been technologically feasible at the time Jurassic Park was in production, Muren collaborated with Spielberg in designing CG shots for The Lost World that were bolder, more dynamic and more complex.

To meet the demands of the grandly conceived sequences, as well as Muren’s commitment to take the dinosaur animation to a higher level of realism, the newly-assembled unit began by developing software or improving already developed software specifically for The Lost World project. Of vital importance was upgrading animation software so that animators could simulate more natural-looking skin and muscle movement. Among the revised programs was Caricature, an animation system – written by Cary Phillips – that had facilitated the subtle facial expressions and lip syncing of the dragon in Dragonheart. “For The Lost World,” commented model supervisor Paul Giacoppo, “we wanted to use Cari’s facial shape-changing techniques for bigger shape changes in the bodies of the dinosaurs – to make ribs appear and disappear when the creatures were breathing, or make muscles flex and unflex as they were walking. After looking at documentary footage, we realized that in real animals there is constant twitching and movement, which translates to subtle shape changes.”

Incorporated into Cari were proprietary tools developed by Jim Hourihan to provide those subtle skin deformations. One such program, called Isculpt, essentially enabled animators to sculpt two different muscle positions – one flexed and one unflexed – resulting in a shifting movement when the computer interpolated between the two. Hourihan also wrote a volumetric displacement program to provide additional movement in the dinosaur skin. “The volumetric displacement software was a means of placing a sphere beneath the surface geometry of the dinosaur,” explained Dan Taylor. “By moving that sphere up and down, we could create deformations in the skin, making it look as if it were shaking or jiggling or bulging or whatever – which was much more effective than just manipulating the skin itself. With the volume displacement sphere, there was a sense of something moving beneath the skin, just as a real muscle would.”

Already set up so that animators could work with a shaded, rather than wire-frame figure, Caricature was further developed to provide a near duplicate of the final creature animation the

night before it would actually be rendered, allowing animators to make last-minute corrections and adjustments. “The TDs would use Cari to do quick renders overnight,” said Giacoppo, “so the animators could see what the dinosaur was going to look like once it was rendered as a final. That was a big improvement. There had been times when the animator would look at the simple shaded version and determine that it was fine; but the next day, when it was rendered, there would be all of these weird wrinkles or other problems that he couldn’t see until it had gone through the entire pipeline. For this show, Cari allowed the animator to see his entire shot at high resolution, in almost real time. That seriously reduced the number of surprises we saw the next morning at dailies.”

“Cari was a tremendous aid,” Dennis Muren confirmed, “because the animators could see the performances faster. And the faster they could review what they’d done, the more opportunity they had to try it again and again and again, until it was just the way they wanted it. Cari sped things up a lot, which ultimately made the animation better.”

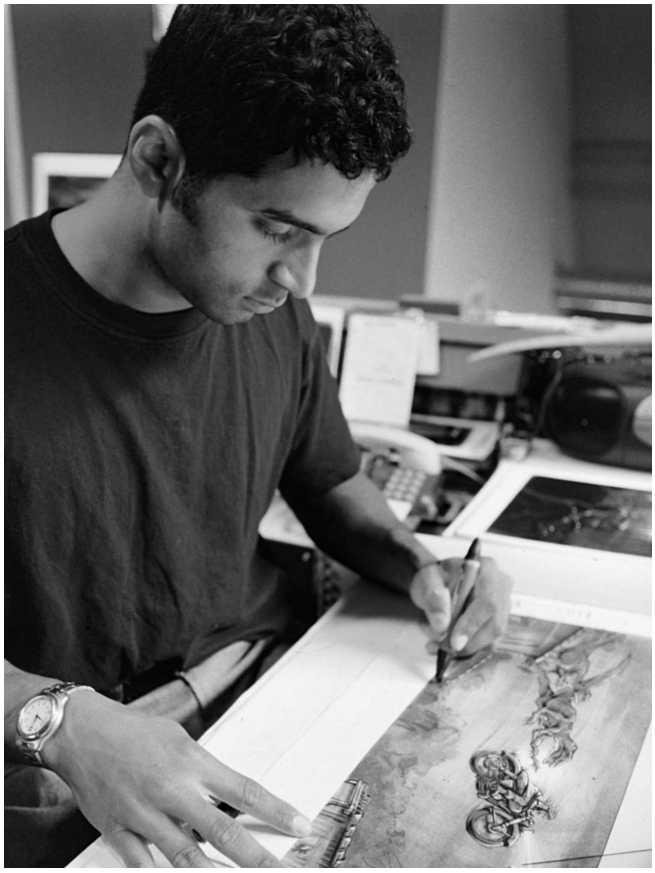
While technical wizards developed more sophisticated programs, Randy Dutra concentrated on the artistic aspects of the project, producing a ten-minute-long behavioral vignette tape – culled from his own library of documentary wildlife footage – through which the behavioral aspects of each species of dino-saur featured in the movie could be determined. “I compiled this video early on,” remarked Dutra, “so that all the animators would have a common reference. The tape proved to be a great teaching tool, and it engendered a lot of discussion regarding animation possibilities.”

As reference footage was being gathered and the appropriate software was being developed, Paul Giacoppo and a small team began building computer models for each of the featured dinosaurs. Winston maquettes were cut into sections – head, legs, forearms and cylindrical body pieces – then scanned at Cyberware. “Once we got those sections scanned in,” Giacoppo said, “we started sculpting over the basic forms and rebuilding the models in the computer. The initial scan is comparable to a lifecast of someone’s face. The lifecast itself looks dead; but if you sculpt over it, you can emphasize certain characteristics and produce something that looks more alive than the original lifecast. Similarly, the sculpted computer model looks better than the cyberscan because a person has gone in and made artistic decisions regarding which features and details should be emphasized and which should not.”

Sculpting of the computer models was executed with Isculpt, which – in addition to its animation applications – enabled modelers to build their digital forms almost as if working in real clay. “Typically,” stated Giacoppo, “computer modeling is a process of moving little points around – like trying to move a chain link fence back three feet by pushing one little link joint at a time. Isculpt allowed us to push whole areas rather than little points. Because of that, we could build the models quickly and make fine adjustments quickly. Isculpt made the process much more interactive because it gave us the ability to push and pull and dent and crease and gouge the form – all of the things a sculptor does in clay.”

First created in wire-frame, the models were then wrapped with patches, giving them the appearance of molded plastic – smooth, but still considerably detailed. “One of the things we do at ILM is put detail into the model itself,” observed Giacoppo, “as opposed to relying on bump

mapping and textures for detailing. Wrinkles, for example, are actually modeled in so that they can be animated. Of course, it would be counterproductive to model every detail. If we were modeling an orange, for example, we wouldn’t model every individual pore in the orange skin, because that can be done convincingly through Viewpaint, our proprietary paint system; but we would model the navel and some of the grooves around the navel.”



Shots were conceptualized and translated into a series of rough storyboards, by visual effects art director George Hull, months before the onset of principal photography.

Seven computer models were built to represent the stego-saurus, compsognathus, pachycephalosaurus, triceratops, mamenchisaurus, pteranodon and a baby T-rex – all of which were either new to the sequel or, in the case of the triceratops, new to the digital team. In addition, the parasaurolophus – a background creature seen in Jurassic Park's wide shot at the watering hole – had to be completely rebuilt for its more prominent appearance in The Lost World.

While the new characters were modeled from scratch, existing models for returning characters, such as the T-rex, raptor and gallimimus, were simply modified. Modifications included rechaining – a task taken on by Doug Smith and Daniel Jeannette – so that the old models could be more easily animated. Functionally analogous to the armature inside a stop-motion puppet, chaining allows a stationary computer model to move by providing a structure that represents joints, muscles and rotation points in the body.

Other modifications were implemented to reflect the fact that both male and female genders would be represented in the new film. "All of the computer models built for Jurassic Park were supposed to be female dinosaurs," stated Giacoppo, "but The Lost World also had to have males. So we modified the T-rex model to beef up the male. We got the Winston maquette of the male T-rex, which had a slightly different head structure, and we worked from that. Susan Ross and her painting team also did new paint jobs for the males, based on the Winston designs – the tiger-like raptor and the camouflage pattern that was on the male T-rex."

When live-action plates began to arrive at ILM, Hull further developed his initial storyboards, using Photoshop to lay in hand drawings of the dinosaurs directly over the footage. The resulting digital storyboards clearly illustrated specific dinosaur actions and positions for each frame, as well as overall shot composition.

With the exception of rechaining and the creation of gender-specific structure and skin textures, the Jurassic Park models required remarkably little upgrading to make them workable for the sequel. Given the considerable advancements in digital technology since those models had been built, their suitability and overall high quality were tributes to the craftsmanship and ingenuity of the original film's digital pioneers. "The

way that those models were put together was brilliant," said Giacoppo. "The sculpting and forms were really wonderful. The original modelers had worked out a lot of the technology as they went along, and you could see the progression and improvement of the techniques from one model to the next. The gallimimus was more sophisticated than the raptor, for example; and the raptor was better than the T-rex. It was evident that they had learned as they went from one model to the next; and their work was really impressive. As I started on The Lost World, I felt as if I was standing on the shoulders of giants who had done this great body of work for the first film. We took it a step further – but we couldn't have taken that step if they hadn't built this tremendous mountain for us to stand on."

All of the models had been built by the time filming began in September 1996; and when edited plates began arriving at ILM a mere month later, everything was in place for the CG effects. The Winston and Lantieri teams, too, were well-prepared, the former having completed its dinosaur build and the latter having engineered special effects gags for scenes that would be shot early in the production schedule.

The Lost World opens with a scene borrowed from Michael Crichton's original Jurassic Park novel. A yacht is anchored at an island off the coast of Costa Rica. As a man and woman prepare for a dinner on the beach, their eight-year-old daughter wanders inland where she encounters a compsognathus. Not alarmed by the small, seemingly benign, lizardlike creature, the little girl offers it a piece of her sandwich. Soon, the single compy is joined by an entire pack and, as the scene returns to the beach, we hear the little girl's horrified scream rising from the foliage.

The opening was filmed on Kauai; and, since the scene would feature both practical and computer generated compys, crews from Stan Winston Studio and ILM were on hand for the three-day shoot. Physical interaction between the little girl and the small dinosaur was captured largely with the Winston puppet, a design sculpted by Greg Figiel, with Shane Mahan rendering its final color scheme. "There was a lot of discussion about the compys in terms of color," stated John Rosengrant. "There was some concern about going over the top with these characters, making them too unreal or extreme. We did many variations of the compy color scheme before we found the right one, which was fairly subtle and natural-looking. The compys blended in with their surroundings, and that actually added to the dramatic tension of the scene. One minute you see them, and the next minute you don't."

The compy's diminutive size – which left very little room for mechanisms – and its darting, birdlike movements presented a unique mechanical challenge, taken on by studio mechanical designer Chris Cowan. For the opening scene, Cowan developed a compy rod puppet. "The head and neck were controlled by rods," Cowan related, "but the body and tail were marionetted from above so that the compy could actually jump and hop. It also had pneumatic blinks and breathing, and servo-controlled jaw and head movements."

The eyes for the compy – and for all the Winston dinosaurs – were designed and engineered by Jon Dawe, who had performed the same service for the practical creatures in the original film. "The look of the compy eyes had to be chickenlike," Dawe remarked, "and the blinks had to be lightning-fast. And because there was so little space in the head, the entire eye mechanism had to fit inside a walnut-shell-sized space. I used a miniature pneumatic cylinder that was operated

through radio control. The cylinder was connected to an air tube that ran from the head out the body. I could tap a button on the radio controller and that would trigger a pneumatic valve, sending a pulse of air through the tube and into the head, which made the eyes blink. The air blasted very fast, creating a lightning-quick eye blink."

During the Kauai location shoot, the compy rod puppet was operated by Dawe, Cowan, Greg Figiel and Shane Mahan, with the overall performance orchestrated by Stan Winston. Fortunately, the four-man puppeteering crew had rehearsed before its arrival. "We were supposed to have a day to look over the location and get prepared," Cowan recalled, "and then we would shoot the day after that. But when we first got there, weather had kicked up and they couldn't get the ocean shots that were on the schedule. They were looking around for something else to shoot, and they said, 'Hey, let's do the compy scene!' So we scrambled to get everything together, and we shot the whole thing that afternoon."

Views of multiple compys approaching the child in the opening scene were left to the CG team. A detailed, high-resolution compy computer model was built by Dan Taylor for closeups of the character, while a lower-resolution model was fashioned to expedite the rendering of multiple creatures. "For the compy herd shots," explained Paul Giacoppo, "Doug Smith, Erik Mattson and I came up with a lower-resolution model that could be rendered three times as fast as the full-resolution version. To save time, we only rendered the fully detailed model for the hero compys in the foreground."

With Dennis Muren embroiled in the production of finals, veteran visual effects supervisor Scott Farrar volunteered to shoot background plates for the opening scene on Kauai. The plates were delivered to ILM's match-move department, the first stop for every scene with CG characters. There, match-move supervisor Terry Chostner and a crew of five devised computer files to match the movement of the virtual camera to that of the live-action camera. "To make the virtual camera moves match what the camera on the set did," said Chostner, "we used measurements that were taken on the set. We are very dependent on the information that is gathered at the time of shooting." Those measurements were taken by Jack Haye, part of the ILM contingent that was on set or on location every day that a CG scene was to be filmed. In addition to taking basic measurements with a tape measure, Haye used a laser survey transit system to establish the ground plane. "Since these creatures were going to be walking and making contact with the ground, we had to know if there were any contours or irregularities in that plane." With the ground plane and other measurements to guide them, the match-movers made wire-frame versions of all the objects in the live-action environment and laid them over the background plate for reference and to facilitate accurate interaction with the CG creatures.

Match-moved plates were delivered to the compy animation team – led by Miguel Fuertes – which looked to Dutra's behavioral tape for guidance in creating the performances. "For the compys," related Dutra, "I found footage of ostriches doing a kind of bobbing movement and reptiles engaged in various actions, such as bolting down meat. I also liked the idea of darting movements that would create a sense of unpredictability and smaller scale in the compys."

Despite their almost comical mannerisms and small size, the compys were animated to suggest a predatory and aggressive nature, especially in group shots. "A single compy is kind of sweet

and harmless," noted Miguel Fuertes. "It wouldn't look like much of a threat; and, by itself, one compy might be easily frightened. But when the whole group is together, they are fearless. My feeling was that a large group of compys would be as powerful and fierce as the T-rex. In my mind, the compys were the T-rex cut up into a million pieces."

The opening scene featured as many as twenty-three compys in a single shot – an unwieldy number to hand-animate one at a time. To expedite the process, Dutra and Fuertes created a library of cycles for a range of compy behaviors and movements – hopping, jumping, running, walking, head bobbing, et cetera. "Once we put those cycles into a shot," said Fuertes, "we could see the choreography of the group. We could see if they were intersecting, or how well their positions were coordinated to the actors' reactions. If there were problems, we could go back and adjust those positions. Once the overall choreography was approved, we animated each compy one at a time, giving them individual actions or characteristics. Some of them were aggressive, some were suspicious, some were curious." Animator Peter Daulton did much of the initial blocking-in of the compy herd, while Fuertes assumed responsibility for most of the fine-tuned animation.

Prior to animation, camera movements in the live plates were matched precisely in the virtual realm by the ILM match-move department. To ensure properly aligned interaction between the dinosaurs and the roundup vehicles, match-movers inserted crude wire-frame versions of both into the footage. Lead match-mover Terry Chostner and match-mover Dave Hanks review a background plate with wire-frame overlays.

The individualizing of the compys within the herd extended to their rendering. "We used the Winston puppet as a template for the general look," explained technical director Kevin Barnhill, "but we tried to add some variety in the characters so they would not all look the same. We'd alter their colors a bit, and their skin textures. We also wanted to suggest that there were females and males that were different from each other; so we made some of them more brown, and others more green."

Hunters prepare to snare a cornered pachycephalosaurus during the roundup. Because of its knobby cranium and roughly textured hide, the pachy was among the most densely detailed of the CG models.

The opening compy scene was also a challenge for the TDs in that it involved fairly closeup shots of the creatures, which would be viewed in broad daylight. "Because it was a daytime scene," stated Barnhill, "there was an extra layer of detail that had to be there. There had to be bumps in the skin, a sheen, dirt, all of those things. We are able to do that kind of thing now because we've got the firepower to render much more complex images." Coloring and skin textures on the compys were realized by Susan Ross.

Interaction with the environment also enhanced the realism of the compy shots. Sand in the background plate appeared to be kicked up by the running compys – an effect realized with a particle system program – and shadows were rendered to contour over ruts in the sandy landscape. “Rather than make a flat shadow,” Barnhill explained, “we made shadows that actually rolled over the terrain. If you have a rut in the sand, the bottom of that rut is darker than the surface of the sand. We would use those light and dark values in the plate to tell the shadows which way to distort and how much displacement there should be. Using that displacement technique, we were able to create shadows that were accurately cast on the terrain.”

The opening teaser leads to a scene at the home of bedridden John Hammond, where Ian Malcolm has been summoned. Since the disaster at Jurassic Park, Hammond has been ousted as InGen’s CEO and replaced by Peter Ludlow (Arliss Howard), a cutthroat businessman and Hammond’s nephew. In a last-stand effort to save his reputation, Hammond sends an expedition to Isla Sorna – a behind-the-scenes ‘Site B’ where most of the genetic experimentation for his doomed park took place. InGen’s declining fortunes and a major hurricane have cleared The Island of its human occupants; but the cloned dinosaurs still thrive there. Isla Sorna has become a natural world – a true lost world – and Hammond wants it to be documented and revealed to the doubting scientific community before he dies.

Although reluctant to return to a situation that nearly cost him his life the first time around, Malcolm agrees to lead the expedition when he learns that the woman he loves – a paleontologist named Sarah Harding (Julianne Moore) – has already journeyed to The Island. Accompanied by field documentarian Nick Van Owen (Vince Vaughn), field systems specialist Eddie Carr (Richard Schiff), and his stowaway daughter Kelly (Vanessa Lee Chester), Malcolm arrives on Isla Sorna and is quickly confronted by irrefutable evidence of a Jurassic-era presence. As the ground rumbles with Richter-scale intensity, a small herd of stegosaurs lumbers into frame to drink at a stream.

ILM produced five shots of the stegosaurus herd, composited into backgrounds of coastal redwood forrest filmed in Northern California state parks. A small ILM crew – consisting of Dennis Muren, Ned Gorman, Randy Dutra, Kevin Rafferty, Vicki Engel, plus Jack Haye and his measuring team – was at the site to oversee the filming. Twenty-five- to thirty-five-foot-tall monster sticks provided cast and crew with framing and eyeline reference, while live interaction between the environment and the animated stegosaurs was orchestrated by Michael Lantieri’s effects crew, which shook and otherwise manipulated synthetic tree limbs to suggest the presence of the giant beasts.

A stegosaurus computer model was built by Paul Giacoppo to exactly match a maquette sculpted by Mark Maitre at Stan Winston Studio; however, the model was subsequently modified. “Stan’s shop did a great job of sculpting the stegosaurus,” noted Randy Dutra, “but it had a low-slung tail, which we later raised in our CG model. In recent paleontological reconstructions, they’ve concluded by the anatomy of the hip construction that the stegosaurus tail was held high, suspended by ligaments. The higher tail transformed the silhouette of the animal, and even changed his character somewhat, because an uplifted tail made him look more

mobile and alert.” The scale of the stegosaurus was determined on a shot-by-shot basis, and was guided more by dramatic requirements than a commitment to scientific fact. Although the fossil record suggests stegosaurs may have reached lengths up to twenty-five feet, those featured in The Lost World appeared as long as forty-six feet in some shots.

Once the model was fully constructed, Dutra and Dan Taylor created a walk cycle for the stegosaurus to lighten the burden of hand-animating every shot of the walking herd. The animal’s unusual physiology made the development of the cycle particularly challenging. “The stegosaurus had short front legs and longer back legs,” commented Taylor, who also served as lead animator for the sequence, “and there is nothing that exists in nature today that has that particular physiology. That made the comparative anatomy and movement study for this creature more complex. We used an elephant as reference for the stego’s hind legs, which are similar in some ways, and that worked out well. The front legs, however, were another matter. Randy and I tried many different combinations of elephant and rhino type strides to get the front legs to work. But it got to a point where the stegosaurus was practically screaming back at us: ‘I’m not an elephant! I’m not a rhino!’ We ended up making a series of judgment calls, based on the squatish nature of the front legs, going back and forth with different ideas until we came up with a walk that was pretty darn believable.”

Outraged by the dinosaur roundup, Sarah and video documentarian Nick Van Owen (Vince Vaughn) infiltrate the hunters’ campsite and release the animals, including a caged triceratops. Stan Winston Studio created a mechanical head for the scene. Full-body views of the giant beast were achieved via computer animation at ILM.

Other cages were occupied by additional Winston puppets, such as a baby triceratops that had been created for Jurassic Park, but never filmed. While mechanics inside the baby’s head were retained, body articulation was simplified by replacing the inner mechanisms with a human performer. Lifelike movement was thereby realized through radio-controlled articulation of the head, in concert with a crew member’s performance inside what was essentially a baby triceratops suit. Chris Cowan and fabricator Lynette Eklund attend to the mechanical head.

“There is so much that you can figure out about an animal from the way it walks,” Dutra added. “Dan and I started looking at how the stegosaurus would negotiate its terrain – what the tail would be doing, how the weight of its body would roll. We finally created a kind of bulldog look in the walk. This animal was extremely muscular in the front of its body, with large bones and muscles in the forequarters; and that forequarter strength had to be apparent in the gait.”

Even with an automated walk cycle that could essentially be plugged into shots of the stegosaurs, the animation required a great deal of hands-on tweaking. “As a jumping-off point,

the walk cycle was very helpful," explained Taylor. "But an animator still had to get in there and rework it. No matter how automated things get, there is always a craft involved. We get better at this stuff, and it becomes more and more automated; but that doesn't make the job any easier – it just means that we are freed from that particular task, so we can spend more time on some other aspect. When computers first came around, I heard time and time again that they were going to make effects easier and faster. But they haven't. Computers allow us to push the envelope further; but at each new level, the process takes just as long and is just as hard."

One of the most stunning examples of how far the envelope was pushed in terms of creature animation and photorealism was the second shot in the stegosaurus sequence, in which one of the dinosaurs slowly crosses past camera, revealing exquisite detail. "It isn't an explosive shot," Taylor observed, "it's just an absolutely believable jaw-dropper. That close to the camera, you can see every little detail on the skin: cracks, scars, bird droppings. There is the quivering of the skin as the stegosaurus shakes its head, the breath it exhales just before it appears in frame, a lens flare through the plates as we tilt up to the top. All of those things gave the shot life."

The measured gait and close proximity of the animal to camera required meticulous detail in the painting of the skin texture, a task undertaken by Susan Ross. "It was exciting for me," Ross stated, "because it meant my work was going to be right there, big on the screen, where it would be closely scrutinized." That scrutiny was accommodated by a Viewpaint system that had been upgraded considerably since its employment on Jurassic Park. "Before, we would do our paintings somewhat blind, just guessing what the dinosaurs would look like after the TDs added the lighting and shadows and all of those things. We had to second-guess how it would end up looking on film, and accommodate that in the painting. If we wanted very bright skin, for example, we'd paint the skin even brighter than we wanted it to be, to allow for the color washing out after the lighting and blur had been added. Now, we can actually see our bump maps, and our specular and color maps, all at the same time; and we can adjust our own lighting to approximate how the creature will look in the scene. We are able to paint completely to eye, which allows us to work much faster."

Following the herd, Malcolm, Nick and Eddie find Sarah sharing a sweet moment with a baby stegosaurus. Shot in Northern California, the encounter was staged using a full-size mechanical puppet built at Stan Winston Studio. Initially designed in sketches by Rion Vernon – later modified somewhat by Crash McCreery – the baby stegosaurus was sculpted and painted by Dave Grasso, while Bob Mano executed the mechanics. "Rion also did a color rendering," related Grasso, "and we used that to paint a quarter-scale maquette that was sculpted by myself, Christian Lau and Jon Neill." A full-size clay figure was sculpted by the same team, together with Jackie Gonzales and Ken Brilliant, then molds were taken from each major body section, including the individual vertical plates running along the top of the baby stegosaur's back. John Calpin, Lindsay Macgowan and Lance Gilmer ran foam from the epoxy molds; and then Grasso painted the outer skin.

Preparations for mechanizing the baby dinosaur had started while the creature was still in maquette form. "We measured the maquette," said Bob Mano, "planning where we would position the pivots and what size bearings and cylinders to use. We worked with the art

department throughout the process to ensure that the mechanics would not hinder the artistic look, and that the artistic look wouldn't limit us mechanically. Once we had decided what movements were needed, we used our CAD systems to design the components. Except for bearings and cy-linders, nothing could be store-bought, off the shelf. Every part had to be custom-machined."

A popsicle-stick mockup of the baby, built to double-check the positions of pivot points and other mechanical features, was eventually replaced with real components. Like the other characters, the baby stegosaurus was servo- and hydraulically-controlled through a telemetry device for gross body moves and head, neck and jaw articulation, while the smaller functions of the eyes, nostrils and tongue were all servo-driven and radio-controlled. At four and a half feet tall and seven feet long, the baby was large enough to accommodate the required hydraulic cylinders and servo valves within its body.

Fabrication of muscles beneath the skin was done by Grasso and Judy Bowerman. "Wherever the skin was buckling or doing something strange," Grasso commented, "we had to figure out what to put under there to prevent it from doing that. When we first placed the skin on the neck, for example, it was wrinkling. We put foam construction muscles underneath it to counteract that." The baby stegosaurus' skin was repainted after it had been fitted over the foam muscles and mechanical armature. "I finessed the paint job at that point, because with all the handling of the skin, the pristine paint work we'd done had faded. I painted it the basic color, then went in with a fine airbrush and paintbrush and painted all the little details."

At the Northern California location site, the 400-pound baby was hoisted into position beside a stream, secured to a safety support bar in the ground, and operated by a team of six puppeteers: Mano on the head and neck; Grasso on the mouth; Paul Mejias on the tail; Shane Mahan on the eyes; John Calpin on the tongue; and Keith Marbory on bladders to simulate breathing. "We all loved being on the baby stegosaurus," recalled Grasso. "The character had so much personality, it really gave us the chance to act, which was fun."

Sarah's study of the baby comes to an abrupt halt when the automatic rewind on her camera alerts a nearby alpha male to her presence. The full-grown stegosaur charges, chasing Sarah downstream and into a hollow log, where she is nearly crushed by the animal's powerful, spiked tail. Views of the running adult would be captured entirely through 3-D animation, but closer interaction shots were filmed with a full-size Winston creation. Construction was headed artistically by Mark Maitre and Scott Stoddard, and mechanically by Kirk Skodis and Al Sousa. Working from Crash McCreery concept drawings, Maitre and Stoddard sculpted a sixteenth-scale maquette, which would stand sixteen feet tall and twenty-six feet long when scaled up to full size. "We were commissioned to build about three-quarters of the adult's body," stated Maitre. "There was the head and neck, then a second section that went from the middle of the chest all the way to the tip of the tail. Essentially, its middle section was missing; but it was filmed in such a way that you never saw the middle." Molds were taken from the full-size sculpture of the stegosaurus – the second largest creature the studio had ever produced. Foam latex skins were prepainted; and a fabricating crew that included Keith Marbory, Ian Stevenson, Mike Ornelaz, Judy Bowerman and Jim Charmatz assembled and finished off the exterior.

Like the other large-scale dinosaurs, the adult stegosaurus was controlled with hydraulics and a computer-linked telemetry device – for the movement of its head, neck and tail – and with radio-controlled servos for its facial articulation. To provide a threatening, rattling motion, sixteen individual plates running along the top of the character were equipped with hydraulic cylinders that were run off a kind of mixing board with slide switches. To accommodate shots of the stegosaur attacking Sarah with its tail, the puppet was mechanized to achieve a wide range of tail movement. “The whole tail had a twisting motion,” explained Maitre, “in addition to up-and-down and side-to-side movement. The spiky tail was supposed to come down – just missing the stuntwoman standing in for Julianne Moore – and actually lodge in the ground, giving Sarah time to get away.” In following shots, the stegosaurus slams its tail into the hollow log in which Sarah is hiding. A separate spiked rig was designed and built by Michael Lantieri’s team for the closeup of the tail on the log.

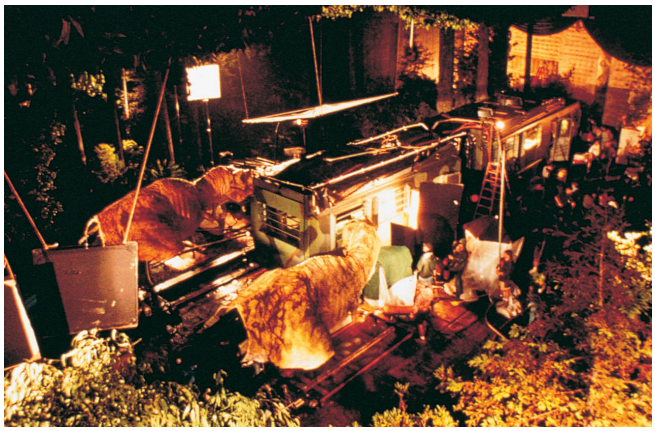
Following the camp scene, Nick and Sarah discover a baby tyrannosaur with a broken leg. A vital character, the baby was brought to life on set through animatronic puppets engineered by the Stan Winston team. Key artists Joey Orosco and Bill Basso finalize the paint job on one of the puppets.

An entirely self-contained unit was requested by Spielberg to allow for long-running shots of characters carrying the baby, unencumbered by lengths of trailing cable. Mechanical designer Richard Landon at work on the self-contained puppet.

The baby dinosaur is first discovered within the T-rex nest. Crew members dress a rotting parasaurolophus carcass on the set.

At the start of filming, the live-action stegosaurus was transported to the Northern California location and put through its paces by a team comprised of nine puppeteers: Kirk Skodis and Mark Maitre on the tail; Al Sousa on the head; Michael Ornelaz on the nose and tongue; and others manning radio control articulation of the facial area. While the stegosaurus performed admirably – even in the less-than-pristine conditions of the red-wood forest – filming of it was postponed until later in the production schedule, when a second unit stegosaurus shoot was conducted on a Universal soundstage. “We had some concerns about doing the adult stegosaurus stuff on location,” recalled Shane Mahan. “We had practiced with stunt coordinator Gary Hyams and Stan and the stunt people – particularly the stunt where the tail comes down on the log with Sarah inside. But we all realized that these were very dangerous stunts and not the sort of thing that should be done first unit. Steven was shooting at a very fast pace; and because of the danger of the stunt, Stan and Gary determined that it would be best to devote one entire day to it. Obviously, that didn’t play into the location schedule. So it was shot later as a second unit thing, with Stan and Gary sharing the direction.”

Sarah and Nick grapple with the injured baby inside the expedition’s mobile laboratory.



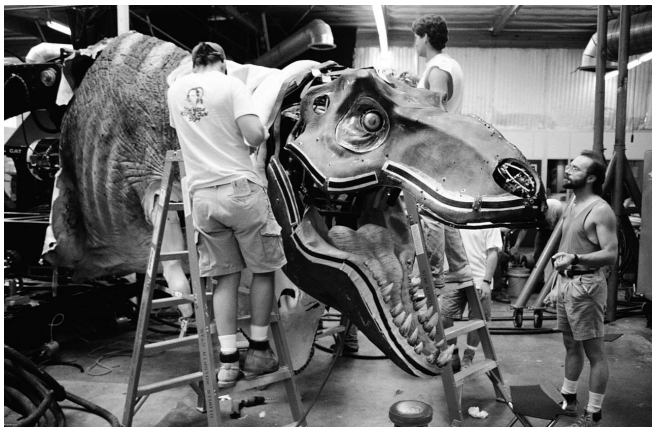
Having followed their infant’s scent to the camp, enraged T-rex parents attack the trailer, eventually pushing it over a cliff. Shots of the tyrannosaurs physically impacting with the trailer were captured on stage through the use of two full-size T-rex rigs built by Stan Winston Studio.

Sarah, Malcolm, Nick and Eddie – what Spielberg would refer to as the peaceful ‘gatherer’ expedition, in contrast to InGen’s ‘hunter’ team – barely recover from the stegosaurus attack before a fleet of helicopters alerts them to the arrival of InGen’s well-equipped hired guns. In motorcycles and custom-built all-terrain vehicles, the hunters instigate a stampede of herbivores and begin rounding up and trapping pachycephalosaurs, parasaurolophuses and gallimimuses. In the course of the action, a panicked animal – chased by a motorcycle – runs through the legs of a gigantic, lumbering mamenchisaur.

Shot in Northern California, the dynamic roundup scene had required months of preparation by Michael Lantieri. The special effects team had provided twenty customized vehicles for the sequence, including motorcycles and military Humvees. Custom features included ‘snaggers’ – mechanical arms that extended from the vehicles, ostensibly used to ensnare game – airbags

that could inflate on cue, and hydraulically-controlled side chairs. A fleet of new Mercedes Benz AAVs – driven by the gatherer expedition – was customized to look like state-of-the-art scientific field vehicles.

Although the T-rex – a carry-over from the original film – did not have to be resculpted from scratch, a male version sporting a modified head was created in maquette form, with distinguishing features then incorporated into the full-size puppet. A new paint scheme, reflecting the brighter coloration often found in male animals, was devised by art department coordinator John Rosengrant.



Joe Reader and technicians John Calpin and Lou Diaz mount foam rubber skin onto the full-size tyrannosaur understructure. Both male and female variants were built from head to mid-torso, then mounted onto motorized carts.

The wild nature of the roundup – plus the fact that, with the exception of specific shots featuring a Winston pachycephalosaur, all of the animals interacting with the hunters and their vehicles would be computer generated – made the live-action shoot one of the movie's most harrowing. "Specific events had to occur at specific points in the live-action," Dennis Muren observed. "For example, at one point the camera had to pan over and see two mamenchisaurs walking up from behind some big pine trees. Just for that one pan we had so many things to figure out. How big do the pine trees need to be in the frame so that the mamenchisaurs will look the appropriate size? How many seconds into the shot before we see the mamenchisaurs? All of that had to be determined right there on the set because there were just too many variables to enable us to plan it out exactly beforehand."

In addition to timing issues, the roundup shoot was complicated by the vastness of the area that had to be covered, since the stampede itself would span some five hundred feet. Also problematic was the tremendous amount of dust kicked up by vehicles and the running horses standing in for the dinosaurs during filming. "The dust looked great," said Muren. "I actually would have liked it if there'd been so much dust that it acted almost as a scrim, with the dinosaurs running in and out of it, and completely obliterated by it at some points. But the problem was how we were going to matte the CG animals into these scenes if there was dust blowing everywhere. We couldn't water down the entire square-mile area before every shot. Even if that had been possible, I wouldn't have wanted to do it."

Intended for specific insert shots, a full-size T-rex leg rig was also constructed. Key artist Mark Jurinko paints the male leg.

Before the slate of twelve CG stampede shots could be animated and composited, lead rotoscope artist Jack Mongovan and the ILM roto department had to clean up the live-action plates. "Not only did we have to paint out the horses," asserted Mongovan, "we also had to deal with the dust. We tried to leave the dust in as much as possible, since they were going to add it to the shots for atmosphere anyway. We had to

look at each individual frame, take a clean section of that frame, and use it to get rid of the horses, without getting rid of the surrounding dust. It was very tricky."

For the roundup and other CG scenes, the roto department also digitally removed match-moving targets employed on location. "Painting out every single target was a big job," stated Mongovan. "Eventually, to cut down on the workload, 2-D compositors created plants in some of the shots to cover up the targets – which was easier and faster than painting them out. We also had to paint out a lot of wires and cables and rigs." Another overall roto assignment was placing CG dinosaurs within the thick foliage present in so many of the background plates. "We had to do a lot of roto to put creatures behind plants or in front of plants. In some of the earlier shots, things were fairly peaceful and static, so the plants weren't moving around too much. But once we got into the rainy sequences – later in the film – the plants were moving all over the place, and that made our job much harder."

Computer models for the pachys, mamenchisaurs, gallis and parasaurolophuses – all based on designs and maquettes from Stan Winston Studio – had been completed by the time roundup plates began to arrive at ILM. George Aleco-Sima had modeled the pachycephalosaurus, which, because of its bony skull, was one of the more complex tasks. "It was a very complicated, knobby-headed, spiky, wrinkly model," commented Giacoppo. "It had to have a lot of built-in detail and character – stuff that couldn't be saved for the Viewpainters. It was the difference between modeling an orange and modeling a spiky pineapple." The mamenchisaur, originally sketched by Crash McCreery and rendered in color by Jim Charmatz, was modeled by Ken Bryan, while the gallimimus – already built for the original film – was simply upgraded. The parasaurolophus had also made a brief appearance in Jurassic Park; but, due to its featured-character status in the sequel, the creature was sculpted and painted by Paul Mejias at the Winston studio, then computer modeled in fuller detail.

Lead animator Daniel Jeannette organized the library of animation cycles for the roundup sequence, working closely with Randy Dutra throughout. While the gallimimus run cycle had been initially worked out for Jurassic Park – and subsequently updated and reanimated by Mike Eames – the pachys, mamenchisaurs and parasaurolophuses represented wholly uncharted animation waters. Paleontological theory that the eight-foot-long, five-foot-tall pachy was an herbivore that used its strong, bony cranium to defend itself led Dutra and his animators to use North American rams as a modern-day reference for the animal's behavior. "Rams provided a solid starting point for the pachys," remarked Dutra. "We used them for referencing how the pachy would rise on its hind legs and tilt its head just prior to bashing something. Because animals are very efficient and don't waste energy, we thought that the pachy's body and neck should stay relatively loose until just before the moment of impact. At that point, everything would tense up to give the punch its greatest power. We also kept in mind that the pachy was a grazing creature, like a goat, so it wouldn't have been overly aggressive or predatory in nature."

Among the largest animals ever to walk the earth, the long-necked mamenchisaur is believed to have been nearly fifty feet tall and some one hundred feet long. The problem in animating the great beast was that there was no modern-day creature that could be used as a singular reference for the movement. "It is difficult to even imagine an animal of that scale," noted

Dutra, “but there were some behavioral things I tried to pull from animals we know today. A giraffe, for example, has a wonderful lope in its walk. When it is running, its extremities make a graceful circular motion, a gathering and stretching. Animator Hal Hickel and I also wanted there to be a majesty to it. The mamenchisaur’s gait had to have a natural flow – if it hadn’t been graceful, an animal of that size and tonnage would have rattled itself to pieces.”

Overall, the stampede animation was expedited by walk and run cycles developed for all of the roundup dinosaurs, as well as path scripts that enabled animators to draw a path in the background plate to determine the course of each individual creature. “This was not at all the way we had done the gallimimus stampede for Jurassic Park,” remarked Muren. “For that scene, we had built up the shots one by one. We would lay in a cycle and modify it; then put in another one and modify it, and so on, making sure that animals didn’t collide with each other or intersect. But on this film, we could simply lay a path on the ground, and the models would automatically move along it. As a result, we could make changes easily without having to go back and reanimate an animal from beginning to end. If there were problems with animals crossing in front of each other, or the composition of the stampede wasn’t right, we could change the path merely by redrawing it.”

For practical shots of the modular lab trailer slipping over the cliff – the result of repeated blows by the T-rex – Michael Lantieri and crew rigged the trailer to jackknife, then suspended one module by its boot over a deep pit on stage or off the side of a parking structure. Bluescreen material laid at the bottom facilitated the compositing of plates for vertiginous down-angle views.

Also shot on stage was a scene in which field systems specialist Eddie Carr winches the imperiled trailer to his utility vehicle in an attempt to stop its fall, and is promptly attacked by the predators. T-rex actions such as tearing the vehicle open and lifting Carr from its interior were achieved on set with the mechanical T-rex rigs, then augmented in postproduction with full-motion shots provided by the ILM digital team.

“The path scripts used a bunch of squiggly lines moving in a virtual landscape,” Doug Smith added. “It looked as if someone took a chalk marker and left a line on the ground as he walked. We also had scripts that put down pawns on each line, showing approximately how much mass each dinosaur would have and what sort of volume it would occupy. Once we had that, we could choreograph not only where it would be in space, but also in time, to make sure different animals didn’t collide or go through each other. Then we replaced the pawns with our models.” Although similar to the technology developed for Jumanji and 101 Dalmatians, the path scripts and cycles for The Lost World were more advanced. “The technology had more bells and whistles added to it. Animators

on those shows had to work with a smaller library of walk and run cycles. They might have had a walk at five miles per hour, a jog at ten miles per hour and a run at fifteen miles per hour; and they would have to choose which of those cycles to use for a particular shot. For this show, Doug Smythe and Curt Miyashiro developed scripts that bridged those speeds and allowed us to ramp up and down – so we weren't stuck with a five-mile-per-hour walk that suddenly jumps to ten miles per hour. But we still had to go in and make changes with customized animation to transition from one speed to another. There are a lot of shifts in body language that go on when an animal alters its gait; and those had to be hand-animated."

The cycles and path scripts increased efficiency in animating the roundup; but the downside was that the new technology could result in computer animation that had an automated, plugged-in look. "Dennis and Randy were constantly guarding against the cycle curse," remarked Dan Taylor. "If there was no random movement, the cycles could easily begin to look like cycles. The cycles were just a basis, something we could begin building on. In a herd of walking animals, there are unique movements among individuals, but there is also movement common to all the animals. The cycles allowed multiple animators working on the same shot to start with these common movements. Sometimes it was actually more difficult to rework a cycle than to start from scratch. For example, there were a couple of shots in the stegosaurus sequence that did not lend themselves to cycle animation; and those were animated from scratch by Hal Hickel and Chi Chung Tse. Cycles are just another tool in our arsenal. Sometimes they are the appropriate tool, and sometimes they are not. It comes down to making sure we use the right tools on any given shot."

For his part, Dennis Muren remained unconvinced that the procedural approach to the herd animation was better, or even more efficient than laying in one creature at a time. "I had no problem with the walk and run cycles," Muren noted, "but the path scripts required so much reworking to get a really good, random look, I'm not sure they were worth the trouble. And no matter how long we worked with this approach, it never got any easier. Without a lot of hand-tweaking, the animation lacked the human touch. I'd see animals running, but they weren't interacting with each other. The argument is that the procedural approach at least gives you a starting point – and then an animator can always tweak it from there. But that's looking at it backwards. You look at what has been done procedurally, and then you try to add life to it – but only where you think it is needed. That's very different than bringing that life fully to each character from the beginning of the animation process. I don't think the first way will ever be as good as the second; but, realistically, the procedural approach was the only way to get this sequence done on time, considering how many animals we were dealing with."

The large number of animals in the roundup sequence also demanded creative and expedient approaches when it came to final rendering. Fully detailed, three-dimensional texture maps, provided by Viewpaint, were saved for foreground characters, while background animals received lower-resolution, 2-D textures. "We figured out early on how high the resolution of the texture maps would have to be for each creature in the roundup," noted Kevin Rafferty, "and how the texture maps would be applied. Creatures in the far distance could obviously be lower-resolution models, with lower-resolution textures. For those, we simply projected a 2-D texture onto the model with a tool called Make Sticky. But that technique only worked for creatures

that remained in the far distance from the beginning to the end of a shot. If the animal began close to the camera, then ran off into the distance, we had to texture that model with 3-D Viewpaint because there was no way to change the level of detail on the fly. As a result, we wound up having to use Viewpaint for eighty to ninety percent of the roundup shots; but it still saved time and labor to use Make Sticky for the remaining ten to twenty percent."

Other technical direction tasks for the roundup were creating shadows for all of the running animals and ensuring that their feet integrated appropriately with the ground plane in the live-action environment. "The roundup took place in fields and grass," said Erik Mattson, "which meant that the shadows had to be broken up, rather than look like they were on smooth, flat surfaces. We also had to work with the animal feet in the grass so they wouldn't look as if they were pasted onto the background. In the rendering process, we added a procedural noise field to the bottom of the feet that made parts of them transparent so that when we put the dinosaurs back over the background, the grass showed through, making it look as if the feet were actually behind or within the grass."

The stampede was the predominant action of the roundup; but shots keyed to specific animals were scattered throughout the sequence as well. In one, hunters attempt to bring down a roped parasaurolophus. The live-action for the scene had been shot on location, with extras as hunters holding onto ropes attached to a circus pole, reacting as if they were grappling with a large, struggling animal. Dennis Muren quickly determined that the scene would be much more effective if the CG parasaurolophus was animated first, with hunters on ropes – shot as a separate bluescreen element – reacting to already established dinosaur choreography. Both the CG dinosaur and the bluescreened hunters would then be composited into an empty background plate. "It was a much better way to do it," stated Ned Gorman. "There had not been time on location to choreograph the hunters' actions, given the speed at which we were working. So matching our animation to the extras' impromptu, unchoreographed movements might have left us with a fairly spastic-looking dinosaur. It was more important to get the animation right, then direct performers to do actions that would correlate to that animation." The original hunters-on-ropes element was used for reference, and a couple of the live-action hunters were extracted and matted into the final shot; however, most of the action was captured with a new group of hunters, photographed bluescreen at ILM.

At another point in the roundup sequence, the action cuts to a single pachy ramming one of the hunter vehicles. Although in the final cut of the film the 'head-butting' scene would be realized through a CG shot animated by Dan Taylor, a Stan Winston Studio mechanical pachy – designed by Crash McCreery, sculpted and painted by Scott Stoddard, and mechanized by Jeff Edwards and Rich Haugen – was utilized during the live-action shoot. The puppet was built in three configurations: a full-body hero version, an articulated insert head, and a sturdy stunt head for the actual impact. The full-body pachy was articulated through a combination of hydraulics, cables, pneumatics and servos. Cables linked to hydraulics controlled the larger body movements; pneumatics created a breathing movement in the torso, as well as subtle shifting in the legs; and servos – operated from a joystick control – drove the articulation of the facial area. Fabrication of the pachys was done by Beth Hathaway, John Calpin and Scott Stoddard. To limit the amount of patching and sewing needed in the final assembly, a complex, ten-piece mold was

made by Keith Marbory and Darin Bouyssou, resulting in a complete, head-to-tail skin that would not hamper the puppet's movements.

Practical pachys – and seven additional Winston dinosaurs – were also featured in a following night scene, in which Sarah and Nick enter the hunter camp to release the rounded-up animals from their cages. Upon release, the panicked dinosaurs run amuck through camp, causing an explosion by kicking a gasoline can into a campfire, and tearing through tents. Shot at the Los Angeles County Arboretum, the chaotic scene featured several Lantieri gags. Fires were set ablaze, vehicles were blown up, one Humvee was flipped and another was catapulted forty feet into the air.

Among the full-size puppets used to depict the caged animals was a baby triceratops that had been built for Jurassic Park but never filmed. Brian Namanny refurbished the mechanics in the servo- and radio-controlled head; however, the body movements were provided more simply. "We removed the skin from the original animatronic," commented John Rosengrant, "and turned it into a little suit. Then Lindsay Macgowan crawled inside, stood on all fours and performed the cage scene. It was an easy, clever way to give the character some life, since it did not have to run or anything. It just had to look alive and move around a bit ."

A dozen live-action puppets were employed for a scene in which hunter Dieter Stark strays from his group and is killed by compsognathuses. Practical shots were achieved by attaching pneumatic- and servo-controlled compys to actor Peter Stormare, either through a special velcro suit or with magnets. On location, Stan Winston adjusts the position of a compy puppet on the actor.

Stan Winston Studio also provided an adult triceratops head for a shot of the animal running through the fire with a tent draped over its body. The head – mechanized by Paul Romer, Tim Nordella and Lloyd Ball – was covered with a fiberglass and silicone skin by Christian Lau and Jim Charmatz to make it fireproof. Michael Lantieri built a traveling rig to pull beneath the tent canvas and suggest the form of the running triceratops, and the Winston triceratops head was mounted to the front of the apparatus.

ILM contributed a shot of the triceratops emerging from underneath the tent. Paul Giacoppo built the computer model, working off reference photos of the Winston adult triceratops that had been featured in the first movie."Since it was going to be seen in such a quick cut and in the dark," stated Giacoppo, "we built it in fairly low resolution, relying on Viewpainting to cover any necessary details."

Intercut with the puppets were full-motion compys computer generated at ILM. Physical interaction between the compys and their prey required that the match-move team create wire-frame representations of the actor in the plates, thus providing animators with a digital form onto which they could attach the CG characters. Computer

graphics supervisor Euan Macdonald reviews a near-final compy attack shot.

The small stampede that occurs as the animals are released from their cages was also realized by the ILM team. “We did that stampede shot without any procedural systems,” noted Dennis Muren, “and it worked out really well. There were half a dozen compys, a triceratops, a couple of pachys and a parasaurolophus running through the burning campsite. I suggested that instead of using path scripts, we lay in one animal at a time. So we built the shot up, cinematically – and it proved even faster than starting with the path scripts.”

The camp chaos scene included two 2-D shots, as well. One was a digital composite of a fireball, and the other a digital completion of an effects gag shot on the set. “There is an explosion that sends a Jeep up into a tree,” Rick Schulze elaborated. “In the shot, you see two guys in the tree some distance from the campsite; and behind them, the Jeep shoots up like a rocket out the top of the frame. That was a practical element – a burning miniature Jeep – that we filmed here at ILM and composited in. Then the Jeep drops back down through the top of the frame, falling into the tree right above the two guys, who jump to keep from being crushed by the burning vehicle – an effects element shot on location. So the guys jumping out of the tree was one plate; the Jeep dropping into the tree and onto the ground was a second plate; and our shot of the Jeep rising in the background was a third. We married all of those things together in the composite.”

With the release of the dinosaurs, Sarah and Nick cause a temporary setback in Ludlow’s commercial plans. But for lead hunter Roland Tembo (Pete Postlethwaite), there is something bigger than theme part attractions at stake on Isla Sorna. Having successfully hunted every big game animal in existence, Roland has joined the InGen expedition purely for the thrill of downing the ultimate predator – Tyrannosaurus rex.

To lure his objective into the open, Roland kidnaps a baby T-rex from its nest. The nest set was dressed with an eighteen-foot-long parasaurolophus carcass, sculpted by Tim Larsen and Paul Mejias. Swarming CG flies, created in Dynamation at ILM, enhanced the rotted ambiance within the nest. “It was easy to get the basic motion of the flies,” stated Ben Snow. “The challenge was getting them to look as if they were actually flying around the actors in the scene. We had to be careful to build atmospheric effects into the render so the flies wouldn’t look like they were a layer pasted on top of the plate.”

Starting with a concept illustration by Joey Orosco, the baby T-rex was realized both practically and through digital means. At Stan Winston Studio, the creature was sculpted and painted by Orosco and Bill Basso, then mechanized by Richard Landon and Matt Heimlich with self-contained, high-resolution wireless systems designed and installed by Emery Brown and Rodrick Khachatoorian. Three different configurations were built: a battery-powered, self-contained unit for long-running shots of the baby being carried; a self-contained puppet with only limited functions of the head and tail for more distant shots; and a cable and hydraulic version for closeups. Karen Mason oversaw the fabrication; and Mike Measimer, Grady Holder and Gary Yee created the molds.

Initially, Spielberg had planned to get all of his baby T-rex shots with the Winston puppets. After the start of production, however, the director determined that the capture and subsequent rescue sequences would benefit from a handful of shots of a 3-D animated baby. “Stan’s puppet could do a lot,” stated Paul Giacoppo, “but there were a few hero actions they could get more easily with a digital model.” The Winston maquette was scanned to provide a basis for the computer model, which was built by George Aleco-Sima. “Our model was going to be seen at close range, and it was going to be cut in closely with Stan’s, so it had to match the practical baby rex exactly.”

The animation of the creature presented not only the usual challenges of producing natural-looking animal behavior, but also those movements specific to an infant. “Personality-wise,” noted Randy Dutra, “there had to be a piece of the adult in the baby T-rex – but it also had to have some innocence. We tried to make it act as if it is looking at things for the first time, filtering the world through its immature brain.”

Finding the young T-rex tied to a stake and suffering from a broken leg, Sarah and Nick take it to the trailer lab for medical treatment. Malcolm, Eddie and Kelly, in the meantime, have ensconced themselves in a high hide – a titanium cage raised some thirty to forty feet off the ground to provide shelter and an above-treeline view of The Island. Although a practical high hide was built by Lantieri’s team and used for initial shots of the cage being set up, dialogue scenes within the fully-erected structure were judged too dangerous for live-action filming. The solution was to shoot the actors in the upper portion of the high hide, raised only to a height of ten feet or so, on a bluescreen stage. The bluescreen elements were then composited with jungle background stills, photographed by Paul Huston. “Originally, we were going to try to do the backgrounds by shooting small-scale trees,” remarked Ned Gorman, “so we set that up and did a day of tests. From those tests, we could see that miniatures would work for the foreground trees, but not for the wide vistas. So we sent Paul down to Guatemala for five days to shoot our backgrounds.”

Having performed the same duties for ILM’s work on Congo, Huston knew of Mayan temples that provided an expansive, uninterrupted view of the surrounding rain forests. “You climb up the steps of these temples and wind up looking out over the top of the jungle all the way to the horizon,” Huston stated. “I shot several different panoramas, under various lighting conditions, trying to cover whatever we might need for the high hide backgrounds. The hardest part was determining the correct perspective that would be needed from the characters’ point of view. Out in the middle of a rain forest, you really can’t see the forest for the trees.”

While in the high hide, the characters hear the approach of the adult T-rex; and the animal’s presence is confirmed as trees surrounding the perch begin to rustle and sway. Rick Schulze supervised the photography of real small-scale greens, which would be composited with the high hide bluescreen elements and background stills. “We chose Japanese maple trees and other treelike bushes for the stage shoot,” noted Huston. “The trees were very small, but had qualities that made them look like large trees on film. We filmed all of these tree elements, manually puppeteering the branches and trunks to create a whipping motion, as if the T-rex was

moving through them." As a final touch, Huston also computer animated a 3-D flock of birds lifting off in the distance, as if startled by the approaching tyrannosaur.

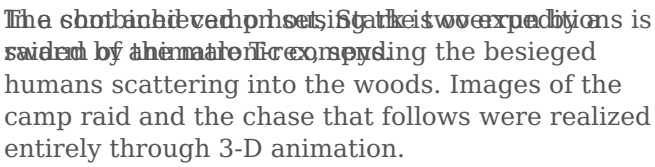
The rustling of the treetops actually signals the approach of not one, but two T-rexes in search of their kidnapped offspring. Malcolm descends from the hide to warn Nick and Sarah at the trailer camp; and, within moments, all three are confronted by the enraged T-rex parents. Having followed the infant's scent to the base camp, the male and female T-rexes proceed to attack the trailer – with the trio still inside – even after their baby has been released. A dramatic centerpiece of The Lost World, the 'T-rex-versus-the-trailer sequence' would incorporate full-size animatronics, complex physical effects gags, 3-D animation and multi-element, 2-D composites.

Most of the interaction between trailer and T-rexes was shot on stage with two full-size mechanical rigs designed, built and operated by the Stan Winston Studio crew. Sculpted and molded in full scale for Jurassic Park, the T-rex did not need to be resculpted, except for some restructuring of the male head to distinguish it from the female. Shane Mahan produced eight male head designs by digitally manipulating photographic images of the T-rex, then translated the approved concept into three dimensions, sculpting scars, a neck wattle and a prominent brow line directly onto a replica of the original head for molding and the generation of new skins.

The compys advance on Stark. With as many as two dozen CG creatures in some shots, automated motion cycles for behaviors such as hopping, running and head-bobbing were essential to completing the animation on schedule. While the cycles provided a good point of departure, ILM animators still spent months hand-crafting specific performances for each individual compy.

Mechanical designer Tim Nordella was tasked with revamping two existing armatures to accommodate the altered configuration and mechanical design of both the male and female T-rexes featured in The Lost World. The single T-rex in Jurassic Park had been portrayed in practical shots with either a full-body puppet or an insert head. For the sequel, two partial-body rigs were built, extending from the head to mid-torso. The new T-rex puppets also differed from their predecessors in that – instead of being attached to a motion platform for gross movements – they were mounted to motor-driven carts, designed by Nordella, capable of moving the 18,000-pound rigs forward or backward on a dolly track laid on the soundstage. Cantilever-style rigging facilitated the raising and lowering of the creatures – which measured twenty feet tall, and nearly forty feet

long – and performance articulation was achieved through the computer-linked control system, integrated and assembled by Glenn Derry, Kurt Herbel and Bruce Stark. A telemetry device actuated the hydraulic and servo mechanics.



The construction of the two expedition vehicles is viewed by the male T-rex, spying the besieged humans scattering into the woods. Images of the camp raid and the chase that follows were realized entirely through 3-D animation.

Jon Dawe created a dilating eye for each T-rex head, using the same drive mechanisms he had devised for the first film. “The only thing I did differently was come up with a puppeteering function that would make the eyes focus forward,” noted Dawe. “There were scenes in this show where it was required to swing down into camera and look directly into someone’s eyes. So I adjusted and modified things to make that possible.”

Fabrication for the two full-scale T-rexes was implemented by Joe Reader, Eric Ostroff, Lindsay Macgowan, Trevor Hensley, Mike Harper, Lou Diaz and Kevin McTurk. Because of its large size, the T-rex was molded in sections; and the resulting skins were carefully joined and blended on the mechanical rigs, then painted in a color scheme conceived by John Rosengrant. The final step in the assembly was sealing the foam rubber skins with thinned silicone to make them water resistant – a protective measure that paid dividends when Spielberg decided to shoot many of the T-rex scenes in simulated rainfall.

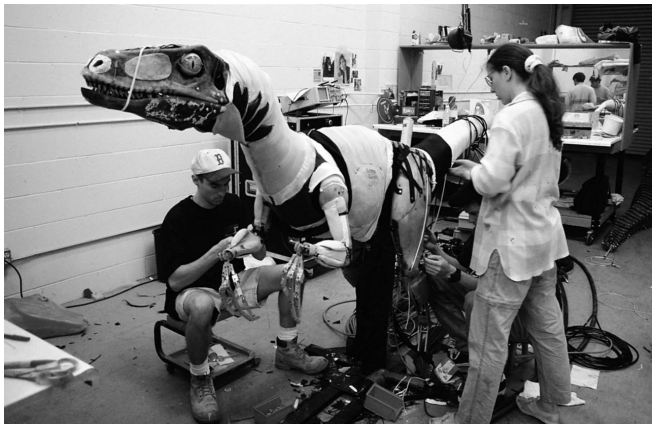
Stage 24 at Universal was designated the live-action T-rex stage. To accommodate the T-rex carts, Michael Lantieri’s crew laid eighty feet of roller-coaster-type track securely into the concrete stage floor. Since laying the track was a major construction effort, the determination was made to build all of the live-action T-rex sets around the massive rigs, rather than move the rigs from stage to stage. Once a live-action T-rex scene had wrapped, that set would be struck and a new one erected. Since the angles and directions of the T-rex’s travel paths were literally set in concrete, sets were built and positioned in such a way that the angle Spielberg wanted on the creatures for any given scene would be accommodated.

Besides laying track in the concrete floor, the special effects team was responsible for some particularly harrowing gags in the nighttime attack sequence, such as rigging the trailer to look as if it was being repeatedly rammed by the tyrannosaur, then pushed over the side of a cliff. The trailer itself had required effects customizing, such as a rooftop communications satellite that could be raised and lowered remotely. On stage, winches and cables were employed to move the 20,000-pound, two-module trailer toward a large pit designed to represent the cliff’s edge. Hydraulics were employed to jackknife the trailer off the side of the pit, and also to make the trailer rock as if being hit by the T-rex. For shots later in the sequence – when the front module of the trailer has gone over the drop and is hanging by its boot – Lantieri hung the trailer from a five-story parking structure on the Universal lot that had been dressed to simulate the rocky cliff face. Stunt people were also harnessed and suspended from the structure and shot over bluescreen for views of Sarah, Malcolm and Nick holding on to ropes as the trailer falls past them. The trailer was shot alone at six frames per second and later composited with the bluescreen performers by Grant McGlashan.

At ILM, harnesses and rigs employed to suspend performers and the trailer itself from the stage pit or the parking structure were removed digitally by the rotoscope team. Beyond such

removals, the sequence also featured thirty-five 2-D digital shots – most supplying views of the drop and the ocean below, both for exteriors and for POVs from inside the trailer. Rick Schulze shot ocean footage from a crane near the Golden Gate Bridge, and that footage was composited into the shots that had been filmed on stage, with bluescreen laid at the bottom of the pit. “We were able to get shots of rough seas and waves crashing up on rocks at that one location,” Schulze said. “To cover all of the perspectives, we filmed a lot of different angles from a Condor crane armed out over the cliff. In some cases, we doctored the perspective and angle after the fact through a process called tiling, in which we could extend shots by collaging various ocean elements together.”

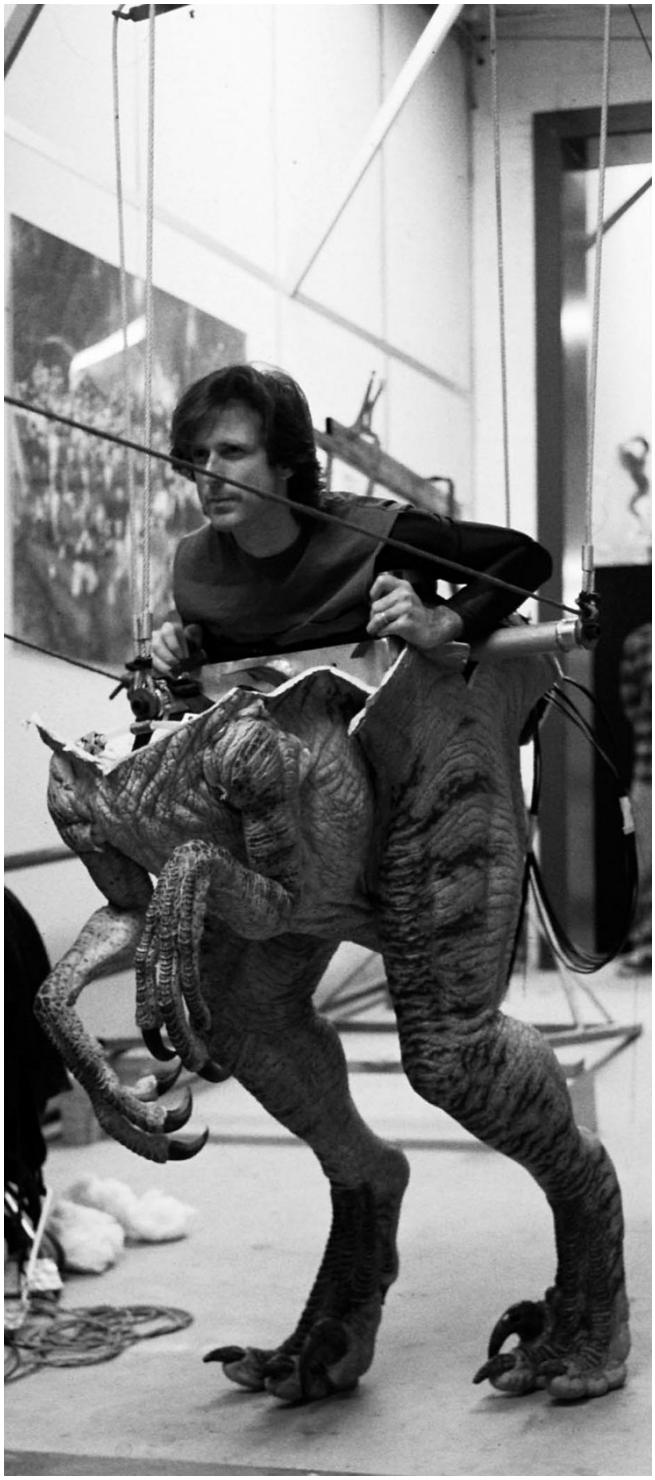
Although the ocean plates were filmed during the day, they were made to look like night shots during the compositing phase. “Pablo Helman was the compositing supervisor for the trailer sequence,” said Schulze, “which was composited in the Sabre. He came up with some great tricks to create a spotlight effect on the water and make it look like it was shot at night.” A 2-D compositing tool, the Sabre was pressed into full-time service by Helman and Caitlin Content. “The Sabre is Discreet Log-ic’s software, primarily; but we have beefed it up with a number of proprietary tools.” Compositing supervisor Jon Alexander led a second compositing crew that used proprietary in-house tools to composite the high hide sequence, some shots in the trailer sequence and numerous others.



Prominently featured in the first film, velociraptors would also figure into the narrative for The Lost World. The Stan Winston Studio crew modified existing raptor armatures to accommodate new hydraulic mechanisms, and created more lifelike skin movement by fitting simulated musculature over the armatures. Artist Dave Monzingo and Lynette Eklund assemble the musculature for one of the raptor puppets.

New foam latex raptor skins were painted in two color schemes – one for the female, and a second, more colorful variant for the male. Tim Gore paints a head skin for a male raptor.

In addition to transforming day ocean elements into night, the digital team added CG rain to their shots so that they would match up with stage and location footage that had been filmed in a simulated storm. In fact, Spielberg had set more and more of the movie's scenes in rainfall as production progressed; and, as a result, ILM ended up adding either CG or practical rain elements to a large percentage of their shots. "We generated the CG rain through Dynamation," observed Schulze, "and, in most cases, it was the only way we could have added rain to these shots. Many of them involved big, complicated camera moves; and there was just no way we could have matched those practically. It would have required a huge motion control crane and an enormous grid of rainmakers – which would have been a nightmare. Overall, the CG rain worked pretty well, especially when we had the time to finesse it."



John Rosengrant donned a special leg rig for specific low-angle shots of the raptors in motion.

Exterior views of the drop also utilized model photography of a practical cliff miniature, eight feet square, constructed by Paul Huston. "I built the cliff out of heavyweight aluminum foil so that it could be easily reshaped for different views and perspectives," said Huston, "then I painted and photographed it. I did lineups for each shot in the sequence to determine the perspective, being careful to match the lighting, the textures and the set dressing they'd had on stage during live-action filming. The lighting was problematic because it was a night shot, and there was no motivated light – where would it come from? So I had to work with that quite a bit to get it to look realistic. After I shot the stills, I scanned that film and brought it into Photoshop to make minor changes, massage the perspective and add detail to specific areas. We did all of that in 2-D. The original plan had been to use the photographs as texture maps on a 3-D cliff model. But it became clear that these shots didn't need to be 3-D, just because of the way the camera moved and its distance from the cliff. 3-D would have added a lot of unnecessary work to the shots."

As the sequence progresses, Sarah falls from the end of the trailer – still hanging precariously against the cliff side – onto a large window at the back, now suspended in midair. Although the glass withstands the initial impact, gradually it begins to crack beneath her weight. Both the ocean view, seen through the glass, and the cracks themselves were added by the digital team. “Except for a few little scratches,” stated Schulze, “there had been no attempt to create the cracks in the glass on stage. We shot broken glass for a day, then collaged the best elements together and animated them in Sabre. We also did subtle, but important, things like refracting the background in the glass and adding background movement.”

A three-dimensional computer model of the trailer was built by Howie Weed and employed for wide exterior shots of the unit hanging from the cliff and its ultimate fall to the rocks below. Weed started the modeling process by photographing the real trailer interior and exterior for reference, then replicated them in great detail. “When it was done, the trailer was a really big, dense model,” explained Paul Giacoppo. “In fact, it was almost as dense as the model we had built for the dragon in Dragonheart – which was our biggest model ever.”

Shots of the attacking T-rexes that had not been captured with the practical rigs on stage were assigned to the 3-D animation crew. Rather than look to Jurassic Park for guidance in animating the adult T-rex, Dutra initially discouraged study of the first movie as reference. “I did not want it to be a given that the animators would go back and simply reference the work on Jurassic Park,” Dutra related. “Lost World was a new film with new challenges and possibilities. I thought it was better to discover our own solutions – and we did. Then later, and with far more critical eyes, we referenced applicable ‘bits’ from Jurassic Park. The T-rex, for example, had certain traits and mannerisms in the first film; and it followed that the rexes in this one would exhibit some of those same traits to maintain continuity with the character.”

“The T-rex was making a repeat appearance,” elaborated Dan Taylor, “and we realized that if he was too different from what he had been in the first movie, there would be some confusion. If Mel Gibson were to do the next Indiana Jones movie, he’d be great – but you’d still kind of miss Harrison Ford. This was the same idea. So Randy and I reviewed the first movie, just to see if there were any specific rex mannerisms that we should incorporate this time; and there were. The neat thing was that many of the mannerisms we added were those that Randy had animated in the first place for Jurassic Park.”

A key behavior taken from the first film was a hard side-to-side movement as the animal scans the landscape for prey. Featured in shots of the rex first breaking out of the disengaged electrified fence in Jurassic Park, the behavior was incorporated into several T-rex shots in The Lost World. One was in the T-rex-versus-the-trailer sequence – animated by Jason Ivimey and Doug Smith – in which the two rexes advance on Eddie Carr as he attempts to pull the trailer from the cliff side using his AAV. As storyboarded, the rexes would emerge, ghostlike, from a blanket of mist and rain. “The look Dennis was going for was like something out of King Kong,” commented Ben Snow, “with the rexes almost floating out of the mist. We used a flash pass to create a sense of them emerging from the depths of the forest, then mixed in a Dynamation rain pass.”

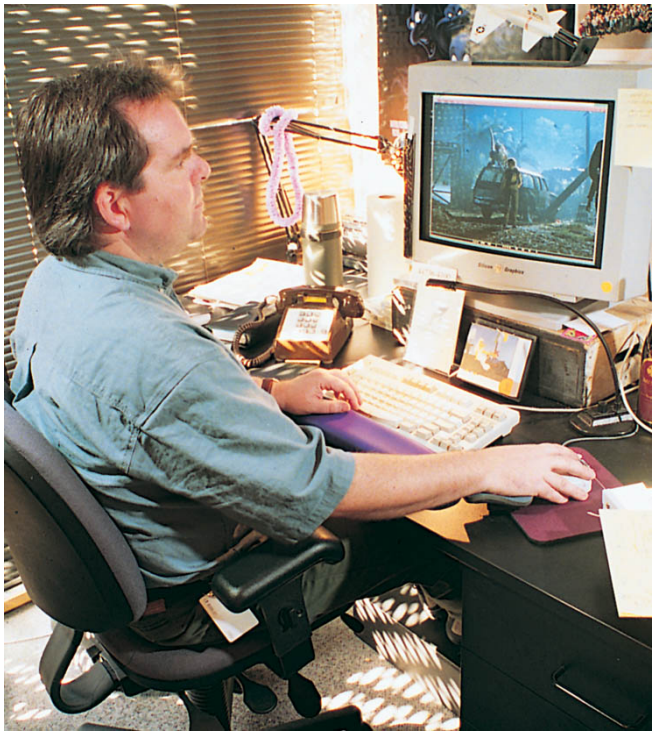
In the following shot, one of the rexes lifts Eddie from the car in his mouth. Rather than animate a CG rex and CG Eddie Carr for the shot, a stuntman standing in for Richard Schiff was actually lifted by one of the T-rex mechanical puppets on stage. “We did tests for several days with Gary Hyams,” recalled John Rosengrant, who puppeteered the T-rex head for the stunt, “with the stuntman harnessed to the T-rex. It was supposed to look like he was being picked up by the leg; but his weight was actually being carried in the torso area through this harness, with a cable running down his leg and into the rex’s mouth. As I lifted him, a team of stunt guys tightened up on the cable to keep him pulled tautly toward the mouth all the way up. If we had really tried to pick him up and let him hang by his leg, this 18,000-pound T-rex rig would have ripped it off.” Even with the safety precautions and days of rehearsal, Rosengrant was understandably nervous about puppeteering such a potentially dangerous stunt. “I was Joe Concerned about the whole thing; and the night before we shot it, I hardly slept. I just kept reviewing the cues and marks in my mind. What made my job particularly difficult was that I had to hit those marks by going off the image on the monitor. The 2-D image was fine for up-and-down and some side-to-side movements, but it didn’t give me a very good perception of depth. So we set up some markers around the monitor – C-stands with balls stuck on the ends – to help me find my marks and determine the spatial relationships between the stuntman in the car, the car windshield and the T-rex head. I had to find just the right spot to pick this guy up without pile-driving into either him or the windshield.”

A velociraptor surveys its surroundings during a scene in which expedition members are pursued through a field of head-tall grass by the deadly creatures. Although Winston insert heads and tails were used sporadically, and two CG cuts revealed the animals in full motion, tension in the sequence was heightened principally by having the raptors remain hidden in the grass.

The chase culminates in the lab compound, where the protagonists seek shelter in abandoned buildings and cars as the predators engage them in a harrowing game of cat-and-mouse. Winston crew members position an insert raptor head for a POV from within a vehicle.

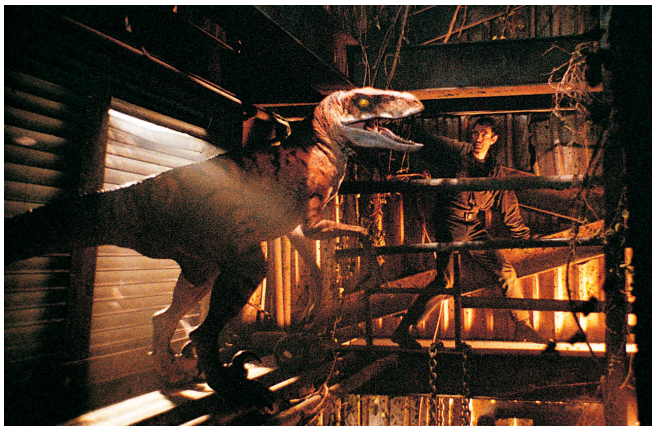
In search of prey, a determined raptor tunnels into a compound building.

In the next shot, CG T-rexes flip a CG Eddie into the air, and, grabbing their victim at either end, tear him apart. “Steven had boarded the two rexes pulling Eddie apart,” stated Dan Taylor, who animated the scene. “But when we got all of the elements together, he saw how intense it was, and he was worried that he wouldn’t be able to get a PG-13 rating for the picture. So we went through a process of toning it down, making it darker and playing it a bit more mysteriously. Eddie is still torn apart by the rexes, but it isn’t quite so ‘in-your-face.’”



Computer graphics supervisor Kevin Rafferty studies one of twenty CG shots produced by ILM for the sequence.

With the sabotage of the hunter’s camp and the T-rex attack on the gatherers’ trailer camp, the two groups are obliged to band together and make their way to the abandoned InGen lab compound, where they hope to make radio contact with the mainland. In the course of their journey, hunter Dieter Stark (Peter Stormare) strays from the group and finds himself lost in the forest, where he is preyed upon by a pack of compys.

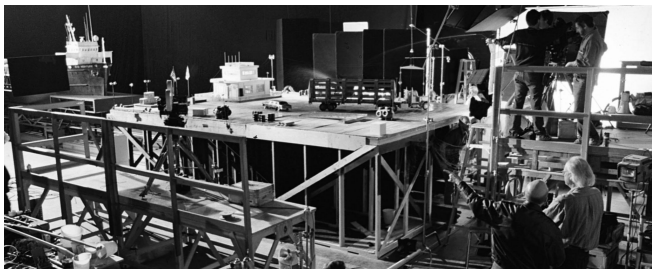


Expedition leader Ian Malcolm (Jeff Goldblum) is stalked by one of the Winston raptors.

On location in a narrow canyon, Stormare was filmed interacting with a dozen compy puppets built by the Winston crew. Chris Cowan devised four different types of puppets to cover a wide range of compy behaviors for the attack scene. “One was an attack puppet,” said Cowan, “which had high-strength, nonstretchable fishing line that went through its head, through the actor’s clothing and into a special velcro suit that allowed us to attach the compys anywhere on his body. The line came out the actor’s leg and led off to a puppeteer who yanked a controller to make the compy head move and bite where the string was attached. We built four attack compys, each with full blinking action, body pivot and a pneumatic tail that could whip back and forth. Then there were four additional background versions without the blinking or tail actuation.”

Another type of compy built for the scene had high-powered magnets on its feet. “We taped matching magnets to Peter’s costume to hold them on,” said Cowan, “so he could reach up and pull these compys off his body. That helped sell the illusion that they weren’t all just attached. We built seven of those compys. None were mechanized, but they had springs in their necks to create some movement as the actor flailed around.” Hero puppets were mechanized with servos

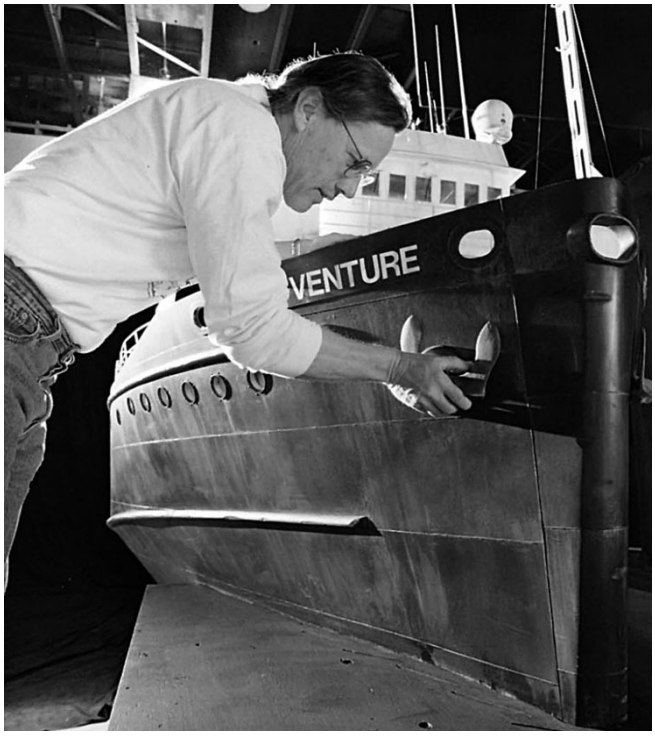
to create full head movement, as well as pneumatic blinks and tail articulation. “The jaw of the hero compy was controlled through a telemetry hat, while the head was radio controlled. It also had little servos inside the body to create a breathing action. Through custom electronic circuits – designed and built by Emery Brown and Rodrick Khachatoorian – we could control the speed and the volume of the breathing.” A superhero version had all of the functions of the hero, in addition to fully articulated arms. Several stunt compys made solely out of foam latex completed the stable of puppets used in the sequence.



Unlike Jurassic Park, whose dinosaurs were island-bound throughout, The Lost World transports the action into an urban setting when an InGen barge carrying a sedated T-rex crashes into a San Diego harbor, allowing the dinosaur to escape into the city. The crash was executed on stage at ILM, with a track-mounted ship rigged to collide with a miniature dock. Dennis Muren and visual effects producer Ned Gorman look over the setup prior to a shot.

Pyrotechnician Geoff Heron and effects rigger Rob Clott ready one of the buildings for a retake.

The scene would also feature eight shots of a computer generated compy pack advancing on Dieter. For those shots, Peter Stormare was first filmed reacting to the absent animals. The live-action material thus obtained was then match-moved by Terry Chostner and his crew before being turned over to animators Miguel Fuertes, Peter Daulton, Mark Powers, Bill Wright and Victoria Livingstone. Because the sequence was filmed with a Steadicam, with very little set data collected, it was one of the more difficult scenes to match-move. “We had to do what we call ‘matchimation’,” related Chostner. “We built a wire-frame that represented the actor, and matched his actions with this wire-frame skeleton. That gave the animators a digital representation of Dieter that they could attach their compys to. We have to do that any time there is direct contact between a character and a CG model.”



Modelmaker Keith London secures the anchor on the twenty-six-foot-long ship model.

Animation for the compy attack scene included the ritualistic head bobbings, runs, hops and leaps that had been seen in the opening sequence. “The compys had to look wired,” Randy Dutra remarked. “I wanted them to have a kinetic sparkle as they ran across the ground – like land piranhas. The way I visualized it, these small animals would run by so quickly, you’d think, ‘Whoa – what was that?’ You’d just see them out of the corner of your eye, and then they’d be gone.”

Although the compy attack scene had been initiated early in ILM’s schedule, the tweaking and perfecting of the animation continued until just two weeks before ILM’s final delivery deadline. “After living with these compys for months,” noted Miguel Fuertes, “it began to feel as if they were sucking the life from us. The compys became more and more animated and real; but the animators began to look more and more dried up and dead. They sucked us dry and took all our energies, until we looked like big-eyed zombies.”

Now minus another member of their party, the combined expeditions make camp for the night. Later, the site is raided by the male T-rex, who chases the expedition members from their tents and through a narrow ravine. Both the camp raid and the ravine chase were shot on stages – the former filmed primarily with the practical T-rex, and the latter requiring full-motion animation, as well as 2-D set extension. “The stage wasn’t really big enough for shots of the rex ravine,” stated Kevin Rafferty. “In the original plates, you could still see lights and rafters at the top of the frame. So our technical directors and 2-D compositors collaborated to redo those plates and extend the set digitally with jungle imagery.”

In the course of the chase through the ravine, one member of the fleeing group is stepped on by the rampaging T-rex and remains stuck to its foot for a few following steps. On location, the

effects crew had dug three rex footprints in the mud. “They filmed an actor in one footprint, acting as if he was about to be stepped on,” said Paul Giacoppo. “Then the actor was filmed in another footprint, acting as if he were dead. For the shot in between, George Aleco-Sima modeled a CG guy that is stepped on by the rex and sticks to his foot. So it goes from a real live guy to a CG squashed guy to a real dead guy. It had to look really good because it was right in your face.”

One of the technical challenges of the night ravine sequence was its chaotic lighting, stemming from torches carried by the fleeing humans. “There were moments where the waving torches would flash across the face of the T-rex,” observed Kevin Rafferty. “So to really integrate him into the scene, we had to flare up the lighting on that area – which washed out both the people and the rex. The lighting was very detailed in that way, and we had to use all of our tools to make it read correctly.” Practical and CG water elements were also added to the ravine chase, to suggest splashing as the T-rex and his prey run through a shallow stream.

Malcolm, Sarah, Nick and Kelly find shelter from the T-rex by squeezing into a small cave behind a waterfall. But the haven is spotted by the female rex when a member of the hunter expe-dition attempts to squeeze into the too-cramped space. After nearly pushing Kelly out, the hunter is lifted from the cave by the T-rex, becoming its next victim. Like the earlier lift of Eddie Carr from the vehicle, the stunt was performed live, with Shane Mahan and the female T-rex puppeteers manuevering the mechanical character on stage. The cave set had been constructed around the position of the female T-rex, then rigged with recycling pumps and sprayers to create a running waterfall. “The rex was supposed to keep lunging toward the cave,” remarked Mahan, “trying to get at the characters inside by snapping and biting and flailing her head around. It took a while to get that part of it worked out because we had to come in at just the right spot, without smashing the rex head against the cave and knocking over the whole set. It was very tight – there was only an inch and a half of clearance on either side of the rex’s head, which was supposed to lunge all the way to within about fifteen inches of the actors inside the cave.” As a precaution, the lunging moves were rehearsed live first, without the actors present. “We got the performance just right, and Glenn Derry from the control team programmed those moves. Then the actors were brought in and we played back the recorded action, knowing it would be exactly as we had rehearsed it, with no errors. The hydraulics and electronics were right on the money, so the playback was absolutely perfect.” The T-rex was reprogrammed for the following shot of a harnessed stuntman being lifted by his arm into the mouth of the dinosaur. “It was set up like the previous lift, except this time the cable ran out the stuntman’s arm and into the rex’s mouth. As before, the pickup point was on the stuntman’s chest, so he was never actually hanging by his arm.” The special effects crew stood ready with gallons of theatrical blood, released from the top of the waterfall to suggest the T-rex’s victim being devoured off-camera.

Still running from the male T-rex, the survivors enter a field of tall grass where, much to their relief and surprise, the predator aborts his chase and turns away. The reason for his sudden retreat becomes clear when three raptor heads rise slowly from the grass in the foreground. Some shots in the sequence would be filmed using Winston’s live-action raptors – two insert puppets that extended from the head to mid-torso, and two full-body heroes. Either version

could be mounted to bobsled-type carts rigged by Michael Lantieri to be pulled through the grass, as if the raptors were running at great speed.

Prominently featured in Jurassic Park, the mechanical raptors were reconfigured significantly for The Lost World. Rich Haugen and Jeff Edwards redesigned the existing armatures so that the puppets – operated through cable-controlled mechanisms for the first show – could be actuated hydraulically for body movements, with some cable-control retained for smaller facial articulation. “We took the same technology we used for the T-rex in the last film and applied it to the raptors for this film,” commented Alan Scott. “We had learned on the first film that using a telemetry device to control a hydraulically-driven character results in a better performance, mainly because you need only two or three puppeteers to articulate the puppet. The cable-controlled raptors we had on Jurassic took up to eighteen people to operate. For the hydraulically-controlled T-rex, we never needed more than eight puppeteers at one time; and, more often, it took only three or four. There was a tradeoff, though, because the cables gave us smoother movement than the hydraulics. So for the velociraptors in The Lost World, we combined both methods, taking the best of each. We drove the moves of the raptors hydraulically, but performed them remotely, through cables.” Because the raptors were too small to contain the larger hydraulic mechanisms within their bodies, the hydraulics were situated within a separate unit, connected to the puppet through cables. “We put as many of the hydraulic mechanisms inside the body as we could, wherever there was room, but other functions – such as the neck, arms and head movements – were cable-controlled from an exterior unit. Like the other characters, the whole thing was operated through a telemetry device connected to the computer.”

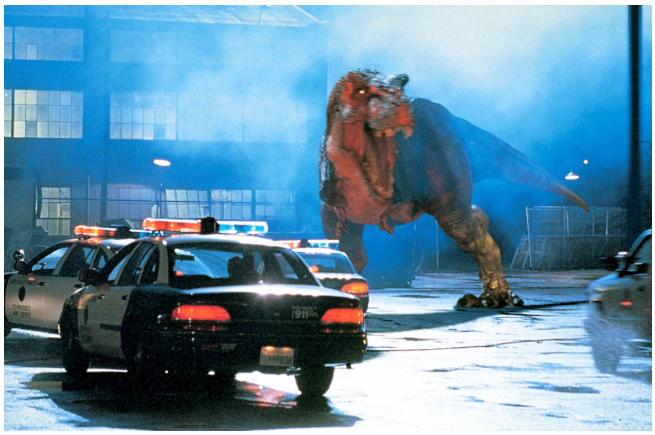
Raptor modifications also included a new paint scheme for the males, designed by Chris Swift. “In the first movie,” John Rosengrant remarked, “the raptors were semi-brightly colored – a cross between a crocodile and a leopard. But, for the most part, the cool lighting canceled out the brighter yellows, and the raptors wound up looking much more subdued on film. To create a male raptor for this film that would appear more colorful, we had to push the color scheme, giving it a lot of orange and more separated, dark tigerlike stripes.”

ILM contributed two CG shots to the ‘raptors-in-the-grass sequence’ – one, a quick and frightening cut of an animal leaping toward a victim. The other CG shot was a high, wide view of five raptors in formation, racing through the grass toward the group – looking much like torpedo trail shots commonly seen in World War II movies. The original plan had been to film the mowing down of the grass with the bobsled rigs, then simply add in full-motion raptors, timing their approach to the movement of the grass. Once on location, however, Muren and Spielberg realized that the rigs could not mow the grass down at a fast-enough speed. Another problem was that the grass, once flattened by the rigs, could not be straightened again for inevitable retakes. The solution was to film plates of the grass in its upright position, then film another series of plates after it had been flattened. Scanning in both sets of plates, Pablo Helman executed a digital wipe, transitioning smoothly from the upright grass imagery to the flattened grass as the animated raptors sped through frame.

Both CG and live-action raptors were featured in the following sequence, in which Sarah, Malcolm, Nick and Kelly tumble down a hill, landing at the gates of the compound. There they

fight off velociraptors as they try to make their way to the lab building to radio for help. More than any other sequence in the movie, the raptor chase in the compound relied on quick and ingenious intercutting between the Winston puppets and 3-D animation. Interaction between the CG raptors and the human performers was also a key element of the scene, particularly in a series of shots in which the animals pounce on Sarah, knocking her to the ground. To simulate the initial impact, Julianne Moore was attached to cables and manually jerked backwards by the effects crew. For the more violent shots that followed, Moore's stunt double performed the actions. "We did digital face replacement for a shot of a raptor jumping on Sarah and wrestling her to the ground," explained Dennis Muren, "putting Julianne's face onto the stuntwoman. We also did lots of digital manipulation for shots of Jeff Goldblum running in and out of the gas station, with raptors leaping after him. We had to do a lot of post work on the plate to get the timings just right. We cut out parts of it and slowed down parts of it to fit the raptor in there. All of the one-on-one, raptor-on-human combat stuff in that sequence wound up looking great on film."

Fifteen to twenty CG shots were ultimately animated for the raptor chase through the lab compound. "In animating the raptor," said Randy Dutra, "we had to be cognizant not only of its size and weight, but of the fact that it was one of the most horrible and efficient predators that has ever lived. That meant it had to be aware of the moment and of its environment; intelligent, fast, powerful, with great eyesight and hearing. All of its senses had to come through in the performance."



Computer generated fog and mist – created through particle systems – helped to blend the computer animated dinosaur into live-action plates shot at a waterfront facility in San Pedro. Wet city streets necessitated the creation of T-rex reflections – either flipped CG elements or separate reflection passes – which were then broken up via the employment of displacement techniques.

The four characters finally make it to the security of the lab building where they place an urgent radio call for help. That help arrives soon thereafter in the form of a rescue helicopter which lands on the lab roof to whisk the survivors away from The Island. Their relief is short-lived, however. From their position in the air, they spot Ludlow and the InGen crew loading a heavily sedated T-rex onto a barge bound for San Diego.

In a series of ILM shots set in the hold of the cargo ship, unscrupulous InGen executive Peter Ludlow (Arliss Howard) gets his comeuppance when the T-rex encourages his youngster to make its first kill.

Four years prior, Jurassic Park had been well into production when Steven Spielberg conceived a new ending for the movie, throwing the ILM team a curve ball and substantially increasing the CG workload. About two months before The Lost World was to commence principal photography, its ending was likewise given an entirely new spin. Whereas the original story had concluded with an air battle between the rescue helicopter and a flock of pteranodons, the new ending would bring the T-rex right into the streets of San Diego. The restructured finale was exciting and dynamic and would feature the computer animated T-rex almost exclusively – and ILM's workload suddenly increased from seventy 3-D dinosaur shots to eighty.

The third act sequence begins with the seemingly unmanned InGen barge crashing into a dock at InGen's San Diego harbor facility, where Ludlow and other InGen stockholders await the arrival of their new Jurassic Park attraction. "The boat first appears out of the fog," explained Ned Gorman, "just as Ludlow walks out of a little boathouse on the dock. We filmed the foreground plate of the principals in San Pedro; but the boat crashing into the dock was done with models."

Lorne Peterson oversaw the model shop build of an eighth-scale boat and dock – assisted by Rob Edwards, Mike Lynch and Giovanni Donovan – while Rick Schulze supervised the model photography. The dock, which included scaled buildings and measured twenty by thirty feet, was constructed in balsawood. The boat, measuring twenty-six feet, was made out of plywood and composition woods, with a sturdy bow designed to withstand the impact. "We shot the crash on the main stage at ILM," said Donovan, "with the boat running on a track. We built three complete docks so we could have three takes; but it only took two tries to get a good one."

Water elements for the harbor crash scene were shot separately and composited into specific areas to suggest the ocean below. "The ocean didn't show that much," Donovan explained, "because it was a night shot and there was a lot of fog. But we did shoot some practical elements to represent water splashing up on the dock as the boat hit. We air-blasted tiny reflective highway beads to get that foamy water look." Other elements composited into the model photography included InGen executives – filmed bluescreen at ILM – fleeing from the dock.

As Coast Guard and harbor officials board the ship to investigate, the T-rex emerges from the hold and disembarks, heading toward the lights of the city to look for his baby – transported by helicopter and being contained at Jurassic Park - San Diego. The full-size boat scenes were filmed in San Pedro, with Muren and the ILM film crew on hand to oversee the background plate shoot. In addition to the animation of the T-rex, the CG crew replaced malfunctioning hydraulic doors used for the live-action filming with CG doors that open as the tyrannosaur exits the hull of the ship. “We also had to add a lot of minutiae to that shot,” recalled sequence supervisor Ben Snow. “We added CG dust and debris as the T-rex hits the doors, to really sell the impact. Then, as he moves off the boat, he knocks over boxes and crates, which had been rigged to fall over practically on the set. Unfortunately, the timing of those effects was such that it was impossible to get the T-rex to move convincingly through the scene and still hit those marks at the appropriate times. Jeff Doran went in and re-synced the timing of those effects gags to make everything fit together.”

In addition to timing issues, the harbor sequence presented interesting lighting and atmospheric challenges, due to thick fog and mist in the live-action plates. “We had to find a way to fit the T-rex within that mist and have him emerge from it,” said Snow. “The mist also affected the lighting — which was broken up into shafts – and shadows, since the rex had to actually cast shadows on this thick wall of fog.” Swirling CG mist was added to help blend the 3-D rex into the scene.

On location in Burbank – representing San Diego in the film – the crew prepares to shoot live-action elements for a scene in which the T-rex attacks a city bus. Michael Lantieri and team engineered the conveyance to implode on cue – as if impacted – while mechanical rigs on the off-camera side of the vehicle were employed to make the bus tip over.

Making its way to a residential neighborhood, the dinosaur smashes through a backyard fence, then drinks from a swimming pool as a little boy watches from his bedroom window. Shots of the T-rex at the pool were computer generated, while closeups of the head as it passes by the boy’s window were shot with the Winston puppet on stage.

Interaction between the computer animated T-rex and the water in the pool required a great deal of finessing by technical director Kevin Barnhill. “We wanted the T-rex to look as if he was being bottom-lit from the pool illumination,” stated Barnhill, “like the look you get when you shine a flashlight up from the bottom of your chin. Stefen Fangmeier shot an element from his own pool; and we used that rippling water footage as a texture to cast onto the T-rex’s body and face.” To create the effect of the pool water moving as the dinosaur

The final shot in the film establishes that the natural order has been restored on Isla Sorna as

dips his head in to drink, more practical water elements were filmed. “We submerged an object that was roughly half the size of the T-rex’s head into a container of water to get the appropriate action. Then we scaled up that element to the appropriate size and composited it into the scene.”

the camera pans slowly to reveal the reunited tyrannosaur family, a stegosaurus herd and, finally, a pteranodon lighting in a tree. Stan Winston Studio artists Jason Matthews, Bruce Fuller and Jacqueline Gonzales sculpt the pteranodon maquette, which was later scanned to create a computer model for the ILManimation team.

The T-rex finally appears in downtown San Diego, creating panic on the city streets. Several urban blocks in Burbank were closed for night filming of the sequence, in which the rex rams a city bus and takes victims among a running throng of pedestrians. Michael Lantieri rigged a bus with high-pressure pneumatics and cables to create, on cue, a dent on the side, as if hit by the huge animal. Hydraulics were also employed to make the bus tilt up on two wheels with the impact, while sliding rigs in the bus interior catapulted stunt people out of the vehicle through breakaway windows.

The organized chaos translated to a big rotoscoping assignment at ILM. “We had a lot of articulation work because of all the running people in the scene,” said Jack Mongovan, “and we also had to paint out some of the rigs and cables and wires that had been used to make the bus tip over and in other street interaction effects.”

Once clean plates had been delivered, Victoria Livingstone animated shots of the tyrannosaur ramming into the bus. “One of the challenges of the scene was that the T-rex was only supposed to be able to run at a top speed of about twenty-five miles per hour,” Livingstone commented. “But from a stopped position, he had to catch up to a bus that was already traveling at about that speed, and hit it by the time the practical bus explosions went off. Unfortunately, the T-rex couldn’t be pushed to run any faster since it wouldn’t have looked believable for his size. This was supposed to be an eight-ton creature – so he had to move like an eight-ton creature. The only solution was to cheat the rex’s starting position, putting him much closer to the bus than originally planned in order for his actions to sync up to those in the background plate.”

Reflections of the T-rex in the wet city streets were added by the technical directors. “Often we had to render a separate reflection pass,” stated Ben Snow, “but sometimes we could just flip the T-rex element and put that in the street. Either way, we would still have to break up the reflection, due to pools of light and different textures in the street. We used a displacement technique to break up the reflections, and used the light values in the plates to determine where the reflection would show and where it would not. We used a similar technique on the cast shadows, which had to be broken up as well.”

In a plan to lure the dinosaur back to the harbor and a waiting barge, Sarah and Malcolm kidnap the baby T-rex from the Jurassic Park - San Diego construction site. To save time and money, only a kiosk and tall entrance gates had been built as live-action sets for scenes of the pair crashing their vehicle through the gates and into the park. For a following aerial view of the park arena and the speeding car, the production relied on model photography, supervised by Rick Schulze. The entire stadium was built in forty-eighth scale, which translated to a thirty-foot-long set that included the arena and surrounding hills. A miniature car was then propelled

on a slotted track and photographed motion control to accommodate a second pass for headlights.

With the baby T-rex in their vehicle, Sarah and Malcolm manage to guide the adult back to the harbor, where it is tranquilized and loaded into the hull of the ship, along with the baby. Peter Ludlow unwisely makes one more attempt to salvage the situation for InGen, and boards the ship in pursuit of the young T-rex. An initial shot of the adult T-rex lifting Ludlow from ship stairs and throwing him against a wall was achieved with the mechanical T-rex, while a following scene – in which the adult encourages his infant to go in for his first kill – featured 3-D tyrannosaurs, animated by Victoria Livingstone and Julie Nelson. “The scene between the baby T-rex and the papa T-rex on the boat is actually very sweet,” Livingstone remarked. “Julie animated the father, while I animated the baby; and together we had to convey a warm ‘father teaches son’ relationship. That required us to work very closely, passing animation files back and forth to keep up with what the other person was doing so that both rexes would work together effectively.”

After Ludlow’s death at the hands of the baby T-rex, the action shifts to open sea shots of the barge heading back to Isla Sorna. The film’s last shot reveals The Lost World in its natural state, with the camera slowly panning from the reunited T-rex family, to a herd of stegosaurs in the distance, to a flock of gliding pteranodons, with one breaking away to land in a tree in the foreground. “It’s a kind of ‘peaceful valley’ view,” stated Kevin Barnhill, who was lead TD on the shot. “The challenge of this shot was that it was in outdoor lighting. It required very natural, golden morning light on everything. We wanted it to look more like something from a documentary than a Hollywood movie shot.”

Working under the guidance of Steven Spielberg, the effects triumvirate of Dennis Muren, Stan Winston and Michael Lanti-eri, with their respective teams, had pulled off something extraordinary for Jurassic Park; and now, four years later, they had done it again. Comparisons between the two films would inevitably be made; and the artists themselves could not help but measure their work against the film that had set new standards in robotic and digital effects.

“The Lost World has bigger and better shots, more interesting shot designs and far more complicated camera moves and lighting than what we saw in Jurassic Park,” Dennis Muren observed, “but it still may not be as stunning to audiences, because there isn’t the shock value of seeing something entirely new on the screen. No matter how much better we did it this time, there may not be the level of amazement there was for the first film. But, despite that, I know we used the tool for The Lost World better than we ever have before.”

“Jurassic Park broke through a lot of barriers,” Randy Dutra added, “and we could not have done this show if we had never done that one. But The Lost World wasn’t a return to anything – it was its own problem to solve. Nature itself was the yardstick, not any past movie or achievement. Rather than a warm, safe return home, The Lost World was like being dropped into the middle of a mysterious jungle to see what we could discover.”

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ELEMENTAL IMAGES

image

ARTICLE BY Ted Elrick

In 1976, at a boarding school some fifty miles outside Paris, sixteen-year-old Luc Besson began writing a science fiction story. For several hours each day, the youth gave free reign to his imagination, envisioning a rousing space adventure set in the 23rd century, where an unlikely hero emerges to save the universe from an impending doom. Writing to escape tedium and loneliness, Besson kept the story mostly to himself, on occasion sharing it with one or two trusted friends.

When the universe is imperiled by Evil, a mass of malignant energy intent upon destroying all life, reluctant hero Korben Dallas, a 23rd-century New York cab driver, joins forces with a genetically engineered warrior, Leeloo, sent by benevolent Mondoshawan aliens to save the day. Luc Besson directs actor Bruce Willis on the set of The Fifth Element, a rollicking science fiction adventure conceived by the filmmaker when he was still a teenager.

Fifteen years later, having established himself as a successful and innovative filmmaker, Besson revisted his manuscript – which had since grown to several hundred pages – determined to explore its cinematic possibilities. His initial attempt at a screenplay, titled The Fifth Element, produced a draft of some four hundred pages. “I didn’t even think about how to make it,” recalled Besson. “My purpose was just to tell the story. Then I said: ‘Okay, that’s good. Now how do I do it?’” Recognizing that the first draft was unrealistic in scope, Besson – with the aid of screenwriter Robert Mark Kamen – divided the story into two parts, then pared the script down to a more workable version that focused on just one.

With a script in hand, Besson began laying the groundwork for the film in 1993. Reuniting with production designer Dan Weil, who had collaborated with him on The Big Blue and La Femme Nikita, Besson surrounded himself with a handpicked, international team of illustrators, guided by French comic art masters Jean ‘Moebius’ Giraud and Jean-Claude MéziÈres. With Besson providing regular input – including detailed histories on each of his characters and an

intricate backstory for his futurescape – the team would spend twelve months together in Paris, brainstorming and dreaming up visual imagery for the film. By the end of the process, they had produced some 8000 drawings, envisioning every aspect of Besson's narrative, down to its most minute detail.

To help realize his unique vision of the future, Besson enlisted Digital Domain to oversee a massive effort combining model photography and digital effects. Modelmaker John Rogers and art director Ron Gress add detailing and fiber optic light sources to a Mondoshawan starship miniature, one of several spacecraft built for the film.

Nonetheless, continued efforts to move the project forward stalled over the next year, and Besson reluctantly laid it aside, moving on to direct The Professional. "The budget was still too big and the effects were impossible to do at the time," Besson admitted. "Everyone said we should wait for the technology to catch up." Never doubting that he would return to it, the director did just that once The Professional was finished; and some twenty years after first putting pencil to paper, Besson at last unveiled The Fifth Element as the opening night offering at the 1997 Cannes Film Festival.

At the heart of the film's narrative is a cosmic event, occurring every 5000 years, in which a gateway between parallel dimensions opens briefly to allow access to the known universe by an implacable dark force – Evil – whose sole objective is to exterminate all life. In ages past, the universe has been defended by Mondoshawans – a benevolent race of aliens who have developed a powerful weapon against Evil. Stored through the centuries in an Egyptian temple on earth, the weapon consists of five interdependent elements, four of them stones containing the alchemic components of earth, water, fire and wind. The fifth – and most important – is a supreme being in the form of a warrior woman named Leeloo.

The picture opens in 1914 at the Egyptian temple where the stones are hidden. Interrupting an archeological dig at the site, a Mondoshawan spaceship lands, and its occupants retrieve the stones for safekeeping, promising to return when the cosmic event is again at hand. From there, the story leaps forward to New York City in the year 2259, where scientists have gathered to brief the president of the Federated Territories on disturbing evidence of a dark planet – Evil – racing toward earth. The returning Mondoshawan ship, with Leeloo on board, is en route to intervene; but before it can reach earth it is destroyed by Mangalores, alien mercenaries in the service of Zorg (Gary Oldman). With nothing remaining of Leeloo but bone fragments from a severed hand, earth scientists – in a last-ditch effort to resurrect the Mondoshawan weapon – race the fragments to a New York City nucleolab where Leeloo (Milla Jovovich) is reconstructed from DNA information contained in The Cells. Awakened after 5000 years, the warrior woman escapes, climbing onto a window ledge hundreds of stories above the ground. Cornered by security forces, she leaps – plummeting through levels of flying vehicle traffic and landing in the back seat of an anti-gravity taxicab driven by Korben Dallas (Bruce Willis). So begins a desperate race against time, as the resourceful cabby accompanies Leeloo to the farthest reaches of the galaxy in a quest to save the world.

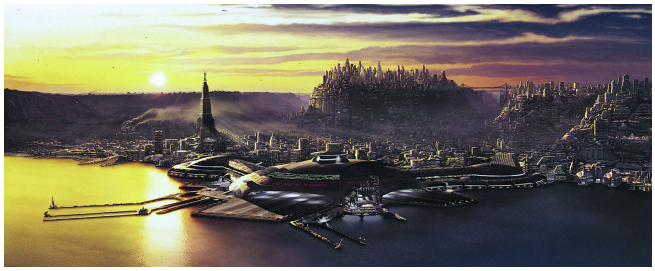
With its fantasy-based, futuristic premise, The Fifth Element was brimming with effects challenges. To support his ambitious vision, Besson turned to Digital Domain, whose short but impressive history included highly regarded work on True Lies and Apollo 13. Assigned to supervise the visual effects was Mark Stetson, a veteran of more than one hundred films, many

in the science fiction genre. Stetson, who joined Digital Domain just weeks before the film was undertaken, would call upon his considerable expertise as one of the industry's premier miniature effects artists to oversee, among other things, an extensive min-iature realization of 23rd-century New York. "This movie was a visual feast," Stetson observed, "and it seemed custom-made for me – especially since I'd been involved in building miniatures of New York on at least six different film projects, from Ghostbusters to The Hudsucker Proxy."

Although the script had initially called for 465 effects shots, that number would be cut to 223 during preproduction. With effects ranging from traditional miniatures to state-of-the-art computer graphics, most of the shots would interweave multiple techniques and multiple elements. In several instances, in fact, Digital Domain's prior record of forty-two stage elements within a single shot – for Apollo 13 – would be doubled.

In the beginning, Stetson viewed his primary task as making Besson – a newcomer to the effects genre – comfortable with the collaborative approach that is fundamental to all visual effects films. "Luc is an auteur," Stetson observed. "He writes, directs, shoots, edits. Of course, he has people working with him in each of those capacities; but he is really a very private person. He likes to keep all that information in a juggling act in his head. So for him to share his ideas, even with one person – let alone a team of effects artists – was not easy."

The success of that endeavor was tested as Stetson and his senior team members – including visual effects producer Dan Lombardo – attempted to interpret Besson's singular take on the futuristic world of The Fifth Element. Neither utopian nor gloomy and fatalistic, it would reveal itself as an endearingly creaky, yet still surviving society whose visual influences were rooted firmly in the comic art of Moebius and MéziÈres. "The film demanded a distinctly new look," Stetson observed, "one that was very fanciful and fantastical, but also photorealistic." Complicating the execution was Besson's desire to reveal his 23rd-century New York in full detail and broad daylight, rather than in the prevailing darkness of bleaker films such as Blade Runner. While effects shots are more challenging when set in a daytime environment, those in The Fifth Element were especially so, owing to the director's unique shooting style. "Luc leans toward very formal compositions. His shots are often composed on center – literally with a vanishing point on the cross-hairs. Early on, Luc and Dan Weil made it clear to us that they wanted Fifth Element's cityscapes to reflect a recognizable New York –



An establishing shot of New York – a digital matte painting by Kevin Mack and Wayne Haag – reveals a landlocked Statue of Liberty, a bustling spaceport and a recognizable, but vastly changed Manhattan skyline. Based on production art by comic illustrator Jean-Claude MéziÈres, the scene reflected Besson's backstory for the 23rd century in which sea levels have plummeted, leaving coastal cities high and dry, and free to expand downward as well as up.

In another wide view of the city, a Thai chef is seen navigating his home-delivery kitchen through a Brooklyn neighborhood. Filmed as a full-size set piece, the flying eatery was mounted on a motion

very different from, say, London or Paris, because New York is a city with a grid. All the streets and avenues are parallel; and when you stare straight down one, you are looking to a vanishing point. With the way Luc composes, that meant the vanishing point would be on center, and you would be seeing to infinity in just about every shot."

base and manually rotated on air bearings. Encoded motion base data and derived rotational data enabled the visual effects team to track miniature foreground and ground plane elements, plus a digitally matte-painted background, to the live-action plate.

To accomplish that perspective, Stetson opted to rely heavily on model photography for the cityscapes, with 2-D digital matte paintings, overseen by Rachel Kelly, extending the horizons. "We could have done it entirely in the computer," Stetson noted, "but as large as Digital Domain is, with its several terabytes of disk space and hundreds of CPUs, there was still a practical limit. A totally CG New York would have been prohibitive in terms of time, storage space and processing power. For that reason, and for reasons of art direction and control, we chose to construct a big set of models." Moving traffic within the city would, however, be realized in part through computer animation, as would certain select shots of the cityscape. "Shots that we chose for a purely digital approach were those that would have been the most difficult to shoot with miniatures – such as portions of the car chase, when Korben's cab dives down into Times Square. Based on my experience with The Hudsucker Proxy – which also featured long falling shots – I didn't want to get into using huge custom stage rigs and models suspended from the ceiling to execute the drops. It is too much work for too little screen time."

Working from thousands of drawings provided by Besson's original design crew, Stetson and his team quickly assimilated the specific logic of The Fifth Element's New York, supported by Besson's carefully thought-out backstory. Though much of that backstory would never actually be revealed to audiences, such logic was crucial in creating a fully functional and believable futurescape. The scenario had earth's human population increasing fivefold and turning to outer space for expansion through colonization of other planets. But terraforming habitable planets had required the exportation of huge amounts of water, effectively dropping the ocean level by 300 feet and exposing deep river canyons, subsequently developed as habitat. Manhattan had become a promontory overlooking these canyons. Skyscrapers had reached heights of two hundred stories; and when still more buildings were needed, engineers had built downward, extending the city an additional four hundred stories below the original ground level.

However fantastic the size of the metropolis, Besson wanted an identifiable New York skyline and an architectural style that would not seem overly futuristic. Buildings would reflect turn-of-the-century to mid-fifties New York architecture, creating a familiar-looking cityscape that was simultaneously bizarre in its monstrous proportions. Poring through photographic books on New York in preparation for the model build, Stetson worked with effects art director Ira Gilford and his team to design the elaborate, 600-story miniature setting. "We did a great deal of research," stated Gilford, "because Mark wanted to duplicate established New York architecture. In fact, he was so insistent that the designs be based on real New York buildings, when I tried to sneak in a San Francisco building for variety, he spotted it immediately."

One tool that would prove a tremendous aid in planning the city models and attendant urban activity was computer previsualization. Using blueprints sent by the model shop to London – where filming was underway at Pinewood Studios – sequence supervisor Sean Cunningham created a rough computer mockup of the city. “We could actually model, in Prisms, our stage layout,” said Stetson, “then make corrections to the miniature build as it was going on – decisions such as how many buildings to construct, how large each one should be to achieve the skyline we wanted, where we thought it would be necessary to break from miniatures, and where we could get away with going into 2-D CG matte paintings.”

By working out specific camera moves in advance, and experimenting with varying scales and lenses, the effects team could also more efficiently allocate resources. “The beauty of Prisms was that we could change the lens or scale and know, right away, if we were hitting the roof of the stage,” noted CG supervisor Karen Goulekas. “We had the previz set up so that if we were flying through the stage floor, the buildings turned red and we would know what had to be added digitally or with a matte painting extension. I could look at it and say: ‘Those red buildings mean we’re going to need a matte painter,’ or ‘This is a wide shot and we’re going to need a lot of traffic.’ It was a tool beyond the storyboard to really break down how many artists I would need and how long it would take.”

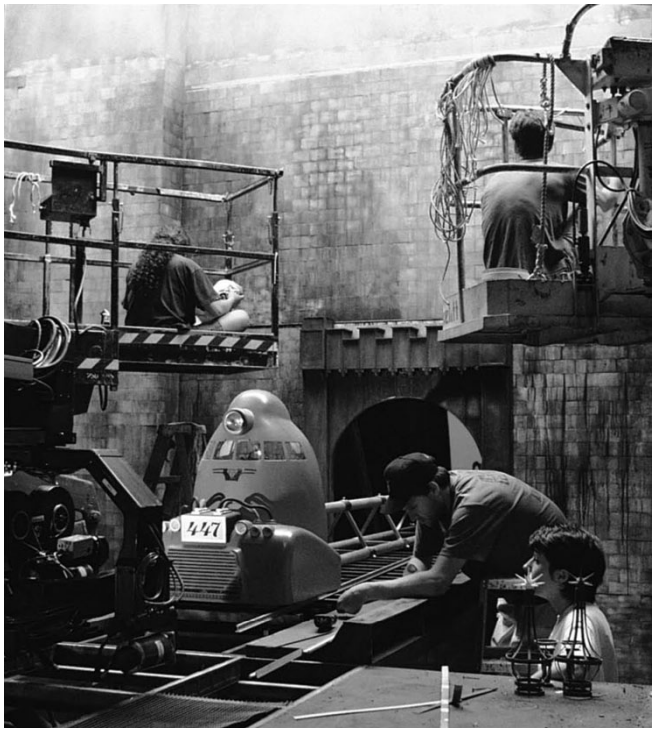
“Karen made a really strong push to keep the animation in Prisms,” Stetson remarked, “which was a smart decision on her part, because it meant that, to the end of the shoot, we were able to animate the city’s traffic in Prisms, using the original rough previz moves. We could send the data back to our model stage, and they could either shoot the movement as planned, or modify the moves to better accommodate the stage environment. We could program our motion control better or simply roto to the CG move, depending on the situation.”

Manhattan street scenes were realized via extensive miniatures constructed under the supervision of Niels Nielsen. Modelmakers add final detailing to the skyscrapers – patterned on existing New York buildings – in preparation for motion control photography on stage at Digital Domain.

Gaffer George Ball at work on the city set. Elaborately sculpted architectural details and backlit window treatments lent verisimilitude to the expansive setting.

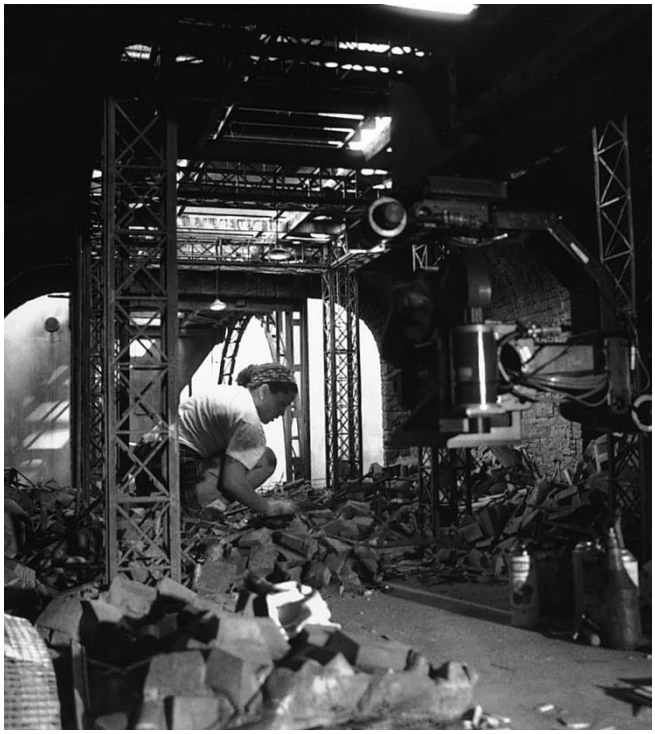
Effects director of photography Bill Neil – with modelmaker Mykel Denis – prepares to film a sixth-scale replica of Korben’s anti-gravity taxi for scenes involving its passage through multiple levels of aerial traffic.

Besson, too, embraced the previz technique as a vital communication link in directing the effects sequences. “There was often a direct path from previz to the completion of a shot,” Stetson noted. “We ended up frame editing in previz. Luc would use it to judge the speed, composition and length of shots. He would approve them or make changes so that by the time we got back to the studio, we had a clear idea of what we needed to shoot and what the moves would be.” Film editor Sylvie Landra also made use of the previz, cutting it into the workprint in progress. “She would come to us with specific requests before the effects were executed,” stated Goulekas. “She’d say: ‘I don’t want to start that move until twenty frames in, so I’m going to need more on the tail end to match.’ Then we’d go back and extend the sequence. It was all very rough, but it gave her a tool to cut the movie; and that, in turn, gave us a better idea of what we needed to accomplish.”



Subterranean sections of the city were also constructed in miniature. Modelmakers and stagehands ready a 23rd-century subway car for a scene in which the taxicab descends to the city’s lower regions.

As designs for the city were finalized, model shop supervisor Leslie Ekker and miniature effects supervisor Niels Nielsen – with a construction crew that numbered more than eighty at the height of the five-month build – began the enormous task of fabricating the models. For the Manhattan cityscape scenes, about twenty-five skyscrapers, some reaching heights of twenty feet or more, would be constructed in twenty-fourth scale. Individual hero models, plus a smaller set in HO scale for shots depicting the Brooklyn high-rise complex where Korben lives, would also be required.



Painter Tannia Montero attends to finishing touches on one of the subterranean sets.

CAD artists and draftsmen were recruited to lay out building blueprints and construction drawings – done either by hand or in the computer – to guide the assembly-line fabrication process. “First, we generated steel and wood frames,” said Nielsen, “and laid them out like big tables so that we could work along them, adding plastic sheeting, acrylic or just built-up layers of foamed styrene. Then we put in windows and all the

detailing. Each building had been picked for its architectural details and its decorative quality, so we were very fussy about that. After we got them started, we turned over certain sections to a sculptor to bring out decorative details such as columns, pillars and headers. Some buildings were encased in clear plexiglass covers – the rationale being that in the 23rd century, architectural treasures were collected, preserved and displayed as museum pieces under glass."

A variety of surface textures, such as brick or rough stone, distinguished the edifices. Brick surfaces were simulated with vacuformed styrene sheets applied to the structures. To replicate stone surfaces, patterns were scribed or, in some cases, painted on with stencil block patterns. Heavily decorated sections were laser-cut. "We would feed information from the CAD drawings into a Lasercamm," stated Nielsen, "which could cut layer after layer of material – nothing thicker than a quarter of an inch. Our crew would then stack those layers to create the finished parts." Nielsen also employed the Lasercamm to cut out thousands of windows, fences, grilles, antennas, roof peaks and fire escape sections.

To create the suggestion of building interiors, Nielsen taped foamcore light boxes to the backside of windows in the structures. Inside each light box, or attached to the window glass itself, were sheets of xeroxed window art displaying various interior settings, ranging from living rooms to office cubicles, or just venetian blinds or curtains. "The sheets were generated on a computer, and we made thousands of copies," Nielsen elaborated. "Crew members would climb inside the buildings, and Mark – or our effects director of photography, Bill Neil – would select the windows most important to the shot and have them dress those out with special scenes. It was a nice trick that read three-dimensionally on camera."

Anti-gravity vehicles and other modes of futuristic transportation were also fabricated in miniature. Designed by Gilford and his team – working with concept drawings from Dan Weil's preproduction art department – the anti-gravity vehicles bore a distinct resemblance to big American cars of the fifties. "Luc was after that specific feel," stated Gilford, who used his prior experience at General Motors and Mattel – where he designed Hot Wheels – to fashion the automotive details. "When you look at a car, tires and wheels are two of the main elements that you see. So to make these vehicles recognizable – even though they didn't need wheels – we still had to design wheel covers and fender bumps. We also made them bulky, with beat-up looking metallic surfaces along the bottoms. The idea was that, even though they hovered in the air, these cars would bounce up against the sides of buildings and get a little beat up when you parked them."

While some vehicles were created in twenty-fourth scale to serve as background miniatures, Korben's dilapidated taxicab and several police cars were built in sixth scale specifically for a breakneck chase through the city's multiple levels of flying traffic. A three-foot master version of each was fashioned, carefully modeled from photos and drawings of the full-size vehicles used during principal photography. Sculpted in jelutong – a light African wood commonly used for pattern making – the cars were then vacuformed to create styrene models, which were detailed with cutout windows and radiator grilles. These masters were then used as the basis for silicone jacket molds from which the final fiberglass cars were produced.

Three versions of the sixth-scale cab were created – a hero one for the movie's opening scenes; another with a breakaway top for the shot in which Leeloo drops into the cab through its roof; and a third, riddled with bullet holes, for views of the cab zooming down into the city's depths following an attack by a phalanx of police. All three models would be intercut with live-action footage, miniature sets and computer generated traffic and cityscapes to produce the elaborate chase sequence.

For the sixth-scale police car, a special gumball lighting rig was devised, since motion control photography of the models would demand an accurately repeatable rotating light. "John Crawford did an initial version for us," Nielsen noted. "Then we turned to Stuart Ziff, who is well-known in the motion control community, and he came up with the ultimate gumball rig. It measured about ten inches from side to side, and it had a little cherry top and amazingly precise movement. It worked like a Swiss watch."

A number of 'quick and dirty' vehicles – trucks, ambulances and briefly seen drive-by cars – were also built, as were twenty-fourth-scale autos intended to be used merely as set dressing, filling up parking garages or occupying taxi stands and police hover stations. Two futuristic trains, in different scales, were constructed for the city – a conventional one that ran horizontally and another seen traversing the 600-story megalopolis on vertical rails. Measuring three feet and eight feet long respectively, the twenty-fourth- and eighth-scale conveyances were fabricated in fiberglass, and attached to a moving rig operated via stepper motors.

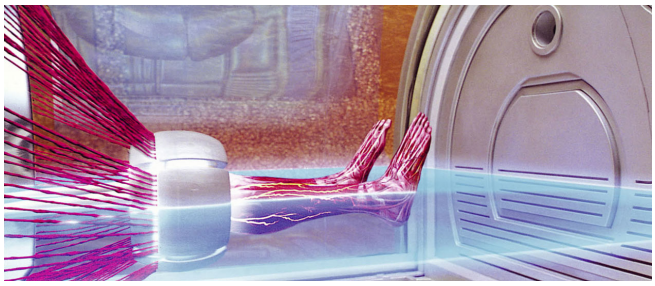
At first, Stetson had planned to rely heavily on miniatures for views of airborne traffic; but as time on the model stage became critical, and a CG production pipeline was established, a shift was made to digital. Under the direction of Karen Gou-lekas, animators mapped out traffic patterns with the aid of simple, low-resolution 'dummy' cars to previsualize the shots. "We didn't want to get bogged down in design issues," stated Sean Cunningham. "We felt it was far more important to get Luc used to seeing flying forms in the previz city in order to pin down specific traffic patterns. We had one-way traffic flying along anywhere from 100 to 600 stories above ground. Luc had determined that it would work in a weave pattern, with the first level going east/west. Drop down fifty feet, and there is cross traffic going north/south. Drop down another fifty feet, and you have traffic going west/east – and so on right down to the ground. Cars would change lanes at intersections, either rising or falling to merge with the cross-traffic."

Because thousands of anti-gravity vehicles were needed for some seventy shots, Cunningham decided to have animators work on groups of cars to get a better feel for the overall traffic flow. Working with grids laid out on the city at fifty-foot intervals, animators could assign cars to random points on the grid, and assign random travel speeds so that each car had a slightly different motion pattern. Once animators were happy with the traffic flow, a series of programming scripts was employed to replace the simple, soap-bar shapes with high-resolution cars, modeled either in Alias or LightWave. The programming scripts also facilitated the CG cars being piped directly into RenderMan for final rendering.

Detailing of the CG vehicles – approximately thirty different car and truck models – was accomplished in RenderMan using special shaders devised by shader supervisor Simon

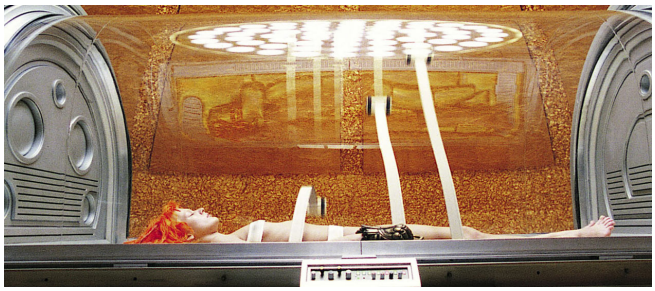
O’Connor. Those shaders featured controls that could produce everything from aged vehicles to shiny, new ones. To accumulate a wide assortment of detailing possibilities, O’Connor found himself obsessively examining real cars with an eye towards digitally duplicating such characteristics as dirt, dents, nicks and rust patches. “For a while I couldn’t go anywhere without looking at cars,” O’Connor recalled. “I nearly crashed my own a few times while driving home, so intent was I on observing those around me.” In addition to devising a mathematical means of recreating photorealistic surface details, O’Connor also included in the RenderMan shader a Fresnel effect, allowing for control of environmental reflections on the surface of the cars. “We could make them appear blurry on bigger patches of surface, since reflection characteristics and chromacity and color saturation tend to change at the edges.”

From a severed bone fragment – all that remains of Leeloo after an attack on the Mondoshawan spaceship on which she is journeying to earth – scientists at a New York nucleolab employ a mechanical extruder to reconstruct her skeleton in cross-sectional slices. Data procured from the Visible Human Database provided scanned images of real bone and brain tissue slices that digital artists were able to incorporate into computer animated shots of the reconstruction.



A tubular loom, moving over the skeleton, weaves raw tissue fibers to create an overlay of musculature. The Visible Human Database proved useful again as a basis for generating texture maps which could be applied to the geometry.

Because the rendering application selected the coloring and detailing entirely at random, controls also had to be built in to allow manual modifications once the overall traffic flow had been generated. “If you had a bunch of subdued-looking cars,” O’Connor said, “and suddenly a shocking pink one popped up, it would look rather strange. Or you might not want five gray cars in a line. So we could go in, if necessary, and manually alter them.” For CG hero cars – which replaced the miniatures when moves were too complicated – Cunningham devised special plug-ins that allowed digital artists to see the real cars in Prisms, then make the appropriate lighting adjustments and hand-tweaks.

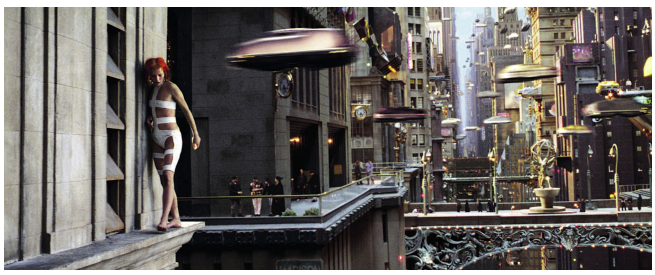


Following successful completion of the procedure, thermal bandages unfurl to swaddle Leeloo’s reconstructed body.

In addition to computer animated traffic, the New York sequences were fleshed out with hundreds of city dwellers occupying balconies, plazas and sidewalks of the towering urban landscape. Although certain down-angle views incorporated small, digitally-rendered humans, executed in rough, representational form, others – in particular, a horizontal reveal of the city as Leeloo makes her way precariously along the building ledge – employed live extras shot on a greenscreen stage and composited into the plates.

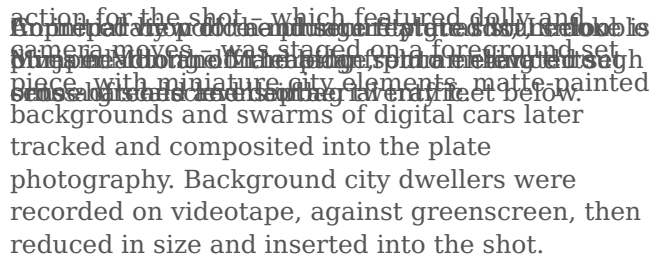
Plans to photograph the extras had originally called for a filmed approach. Fortunately, a less costly, but equally effective alternative was adopted when compositing supervisor Jon-athan Egstad suggested recording the necessary material on Betacam. Since the images would end up greatly reduced when composited into final shots, video resolution would suffice. For the video shoot – accomplished in a single day at Digital Domain – Stetson devised a simple system to ensure that the actors would all be looking in the right direction, and that the camera would capture their images at the appropriate angles. “I identified a dozen or so key scenes where we wanted to add people,” Stetson explained, “and we got the camera reports for those scenes. Then I asked one of our digital artists, Mike Edland, to grab a frame from each shot. He divided up the frames by degrees in tilt, and laid a grid over them, with the grid spacing represented by one grid line per degree. Then, as we were shooting, we had all that on a board so we could identify areas of each shot where we knew we wanted people, and I would set the camera angles relative to that information. From there, our tracking software was so good, we could easily track the people into the shots.”

With digitally produced citizens and traffic suggesting the hustle of futuristic urban life, interactive lighting effects were essential to the creation of a cohesive and realistic environment. “The Fifth Element was one of the most challenging projects I’ve ever worked on,” noted Bill Neil, “not only because of the volume of the work, but also because of the need for visual continuity. Usually you have a few shots in a



Hundreds of stories above ground level, Leeloo (Milla Jovovich) steps precariously along a ledge following her escape from the nucleolab. Live-

sequence, and then you don’t see them again. Here we were looking at creating this colossal urban landscape of the future as a sustained environment over quite a number of shots. It had to hold up to close scrutiny.”



action for the shot – which featured dolly and camera moves – was staged on a foreground set piece, with miniature city elements, matte-painted backgrounds and swarms of digital cars later tracked and composited into the plate photography. Background city dwellers were recorded on videotape, against greenscreen, then reduced in size and inserted into the shot.

To mimic natural sunlight hitting the multitiered city, Neil experimented with direct and indirect illumination on the min-iature set, and developed a look he termed ‘fractured sunlight.’ “Coming from a definite direction, you would expect the sun to light up some of the buildings and cast others in shadow,” Neil observed. “But then the shadow side of the street would be too dull-looking. So we used discrete instruments – spotlights and power lights – to represent reflections coming off other buildings in order to cast light back onto those shadowy areas. We positioned the lights up high, and backlit buildings slightly to give them a sparkle quality that added life to the models. Occasionally, we would use reflectors or reflective surfaces to create a similar effect.”

The aerial perspective of the city vector also had to be considered in lighting the set. “As you go off to the horizon in an aerial perspective, there is less contrast and colors appear more muted. I was filming enough depth in the street scenes where you would expect to see that; so I had to build it in through atmospheric elements and modifications in the lighting. That way, when the elements were separated out with their mattes, the built-in effect could serve as a guide for animators and matte painters to use in extending the scenes digitally. It was a subtle, but important element.”

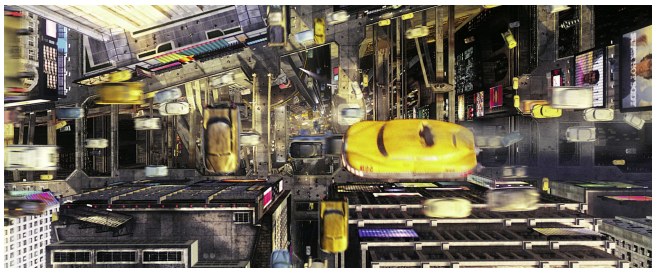
Although glimpses of the city are plentiful throughout Lee-loo’s escape and the subsequent cab chase scene, two establishing shots of New York, depicting more sweeping views, were reserved for later in the film. “Luc likes to surprise his audiences,” Stetson observed, “and one trick he uses is to show an establishing shot for a scene at the end, rather than the beginning of a sequence. I wanted to make the most of those master shots – not only because they were a means of conveying some of Luc’s backstory, but also because they were represented by wonderful production illustrations.”

The first wide master follows a scene in which Korben orders lunch from a Thai chef who sails his home-delivery kitchen right up to the window of the cabby’s claustrophobic Brooklyn apartment. The shot – a wide view of the city that encompasses the airborne eatery – entailed a complex marriage of elements. “The junk-shaped restaurant was a full-size set, mounted on a hydraulic motion base provided by special effects supervisors Nick Allder and Neil Corbould,” explained Stetson. “The entire rig was placed on an air bearing so that the ship could be manually rotated on a central pivot. To track it into the final composite, we captured the encoded motion data as Kuper files. Then, using a Hi-8 camera and an art department maquette, I worked out a previz of the shot and, with Bill Neil’s help, derived rotational angles on timing cues to duplicate the sideways and depth movement of the ship.” Other elements in the shot included a computer generated engine on the bottom of the hull, modeled by Eric Hanson and tracked and locked to the set by Franklin Londin. Foreground buildings and ground plane were miniatures, fashioned in two scales by a team under the supervision of Olivia

Ramirez. The background was a matte painting by digital artists Kevin Mack and Wayne Haag. “The production illustration for the scene was an amazing line drawing – eight feet long – of this futuristic Brooklyn. Although we were most interested in capturing the contrast between the architecture of Brooklyn and Manhattan, I also suggested that the perspective of the drawing be altered so that we are looking at the city from below the Brooklyn Bridge. That strengthened Luc’s concept that the city’s riverbeds had drained and were now built over.”

Miniature electronics and mechanics lead Clark James attends to a prop car parked at a vehicle repair station in the Manhattan street set.

The second establishing shot – incorporating an even wider view of New York – is revealed later in the story, as Korben and Leeloo depart earth in a space shuttle bound for the Fhloston Paradise, in a distant part of the galaxy. Seen from the air, the entire cityscape was a digital matte painting, again executed by Mack and Haag, based on another key production illustration by Jean-Claude MéziÈres. CG modeling was used to create the land and city forms, scanned photography was the basis for the sky, and two layers of Arete CG water comprised the ocean. Sequence supervisor Franklin Londin coordinated animated air-craft, signage and smoke elements.



A vertiginous view of Korben's cab, its roof damaged by Leeloo's backseat landing, was achieved by matting a model car into an urban environment densely packed with miniature and digital elements. Vast numbers of CG vehicles, comprising the multitiered traffic flow, were choreographed and animated with the aid of computer previsualization.

In addition to providing many of the film's urban environments, Digital Domain also made vital effects contributions to other key scenes, including the one in which Leeloo undergoes reconstruction in a New York nucleolab. In the sequence, sophisticated equipment is revealed extracting DNA information – gathered from bone fragments in her glove – and rapidly reconstructing Leeloo's entire body in cross-sectional slices. "We see the reconstruction happen in several stages," observed animation supervisor Daniel Robichaud. "The first is the reconstruction of the bone structure, starting from the arm bone and coming up from the glove. The machine generates little cross-sections of bone and places them next to each other, fusing them to build the whole skeleton. It all happens very fast so that you see the bones growing right before your eyes."

Six squad cars await the fugitive taxi as Korben attempts to elude police. For the high-speed chase that follows, miniature and CG versions of both the cab and police cars were intercut with live-action filmed in full-size vehicles.

Digital Domain art director Darren Gilford went through several concepts with Besson before arriving at a workable approach to the sequence. Data from a scientific endeavor called the Visible Human Data project proved to be the key. Demonstrated at SIGGRAPH, the project database consists of scanned photographs of thousands of millimeter-wide slices planed from a cryogenically-preserved cadaver, assembled in rapid-fire succession. "We thought that was an interesting concept – reconstructing the body in slices," observed Gilford, "and Luc definitely gravitated toward the idea. He wanted the movement to be like a jukebox picking out a record, where the mechanical arm comes out and slices it in." Although Gilford had first envisioned the reconstruction occurring in a vat of liquid, he abandoned that approach due to the difficulty of moving mechanical arms through fluid. Instead, he designed a flat reconstruction bed, along with mechanical arms and a loom that would be seen weaving musculature onto the skeleton.

Completed designs and storyboards for the scene were then turned over to Robichaud, sequence supervisor Joshua Kolden and a team of digital artists.

Attempts by Federation forces to defend the universe against Evil are undermined by Mangalores – a race of mercenary changelings in the service of unscrupulous arms dealer Zorg. Flanked by his compatriots, a Mangalore leader (Vladimir McCrary), cloaked in human guise, reports to Zorg.

With a quick shake of the head, the alien transforms back to his natural state. A complex 3-D morph was devised to achieve the metamorphosis.

To depict various parts of Leeloo's anatomy being reconstructed, the digital team obtained license to apply data from the Visible Human database, animating the reconstruction in Softimage and rendering it in Mental Ray. "We cleaned up the data and isolated what we needed, eliminating parts that were not relevant," explained Robichaud. "Then we used those images as texture maps in our 3-D shots to show the actual slices being built and assembled." The most direct use of the database was a segment depicting the reconstruction of Leeloo's skull. "In those shots, an extruder pulls plates that generate slices of the head with the brain visible on them. Robotic arms pick and place them next to each other to form the growing skull. Since it happens so fast, you see a kind of fractal animation, which is really how the brain would look under those circumstances. It was quite spectacular."

As the reconstruction continues, looms surround the completed bone structure, moving over it with fibers of raw tissue that are woven together to create intricately layered muscles. "We don't actually see the process, but what is left behind is the completely reconstructed musculature," noted Robichaud. "The musculature was a geometry modeled by Jordan Harris and Dan Lemmon. And once again, we used the Visible Human database as a basis to generate texture maps, heavily repainted by Miles Bellas, that were applied to the geometry."

Modelmaker Robert Diepenbrock adds final touches to a Federation warship – part of an armada sent to engage Evil before it reaches earth.

Each of the CG shots in the forty-second sequence contained more than fifty separate elements, composited in Nuke – Digital Domain's proprietary compositing system – and tracked to live-action backgrounds of the reconstruction bed. In addition, the digital team turned to a company called Zygote to model various bones in Nurbs. "Nurbs is a type of surface which is more flexible than the conventional polygonal surfaces most modeling companies deliver," Robichaud explained. "It is infinitely more complex to build objects this way; but once built, this type of surface is more convenient to use because it allows

you to do all kinds of texture mappings and other operations that are not possible with any other type of surface."

Confused by her strange surroundings, the awakened Leeloo breaks out of her reconstruction chamber and eludes the scientific team, climbing onto a narrow window ledge hundreds of stories above ground. For a subsequent shot of Leeloo leaping from the ledge, Milla Jovovich's stunt double, Mirjam Montandon, was photographed performing a twenty-foot drop into a greenscreen airbag. In a subsequent shot, Leeloo is observed plummeting away from camera. Initial plans were to composite greenscreen footage of Jovovich – in which she simulated the fall through arm and leg movements as the camera pulled back on a high-speed dolly – with views of the miniature cityscape. But when results proved less than satisfactory, Stetson turned to Daniel Robichaud for a digital fix.

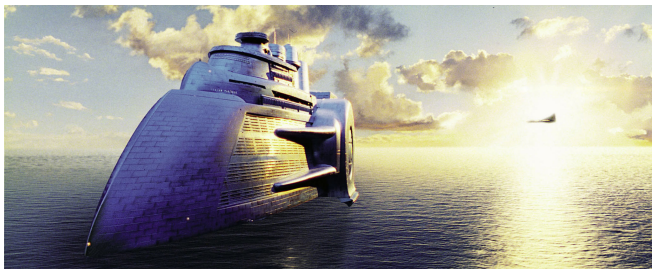
"In the greenscreen element that was shot," said Robichaud, "Leeloo looked like a 2-D cutout that had been scaled down. So the first thing we attempted was a 2-D morph on the plate to add more motion to her arms and legs." Though somewhat improved, the morphed image, too, was unsatisfactory. Finally, Robichaud abandoned the greenscreen element altogether, and instead animated an entirely three-dimensional CG version of the actress. "I took a frame from the plate where she filled the screen, and used that as a texture map to apply onto the rough 3-D geometry of her form. Then I did a complete character animation of her falling." Using a tool in Softimage called Metaballs, Robichaud matched the shape of the body to the image of the texture map and merged them together in a way that formed one unique surface. "Metaballs acts like mercury does when two drops get close enough to each other to merge. It required quite a bit of finessing, but the results were great." The architectural and traffic elements of the fall – seen from a plummeting POV – were realized through seamless transitions from cityscape model photography to 2-D matte paintings to 3-D digital models.

As Leeloo crashes through the roof of Korben's cab, the impact causes the vehicle to drop ten stories. While shots inside the vehicle were filmed in a full-size cab set, anti-gravity traffic visible through the windshield was computer generated and composited in, then blurred to create the impression that it was being viewed through a dirty window.

Harassed by security police intent upon recapturing Leeloo, Korben takes evasive action when squad cars begin firing on his cab. Falling out of formation, he maneuvers the vehicle vertically like a jet fighter, peeling through the horizontal levels of traffic in Times Square and descending into the city's foggy depths for cover. For a series of five shots depicting the dive, the digital team, led by Eric Hanson, devised an entirely computer generated Times Square of the future. "The only thing that was a miniature in those scenes was the cab," observed Stetson. "We could have gone with a CG cab, as well; but using the miniature cab gave the digital buildings team and traffic team a guide for lighting continuity."

Later in the story, an amusing effects gag occurs when a Man-galore mercenary – one of a repulsive-looking race of change-lings who track Korben and Leeloo across the galaxy in a bungled attempt to steal the Mondoshawan stones – reverts from his human disguise to a more natural state with a quick shake of the head. While the Mangalore suits and animatronic heads

were produced in London by creature effects artist Nick Dudman, the two-second transformation would require digital manipulation at Digital Domain.



On a quest to retrieve four Mondoshawan stones, key to defeating Evil, Korben and Leeloo board a commercial space shuttle bound for the Fhloston Paradise, a lavish resort vessel in orbit above a distant water planet. A shot of the shuttle approaching its destination incorporated two model ships, a matte-painted sky and digitally rendered water.

A diva, entrusted with safekeeping the stones, performs at a charity function aboard the Fhloston Paradise. Background grillwork and planet, rendered individually as 2-D matte paintings, were tracked to live-action footage of actress MaÏwenn Le Besco, using encoded data plugged into custom compositing software.

Sequence supervisor Christine Lo and digital artist Thomas Johnson achieved the effect with a 3-D morph – rather than the standard 2-D variant – in order to accommodate shifting perspectives as the Mangalore's head moved. Unable to pick up sufficient detail from a cyberscan of the rubber mask, the digital artists procured a plaster version and scanned that into the computer for a more accurate reading. They then utilized that data as reference to create a highly detailed 3-D model of the Mangalore head. "There was a lot of motion blur in the shot," observed Lo, "but at the same time, the morph was going to be seen in closeup. So we definitely needed to have the highest-resolution model possible." To execute a smooth morph, Lo and Johnson had to ensure that all the points on the 3-D Mangalore head model matched corresponding points on a computer model of the actor's real head. "For example, the tip of the actor's nose had to match the tip of the Mangalore nose so that when the head shifted, the points moved to the correct sections." Animation – which took three months to complete – was accomplished in Alias, with a morphing tool called Key Shape controlling the degree and speed of the transition. The 3-D head was then sized to the original plate and integrated through careful matching of camera position and lighting.

An enormous fireball engulfs the Fhloston Paradise as Korben and Leeloo flee in a stolen ship. Filmed as a separate pyrotechnic element, the explosions were matted into footage of the model – shot twice and rotoed in half – to simulate the ship's breaking apart.

A later shot featuring a similar transformation – aborted as the Mangalore manages to regain control of his human countenance – was done completely as a 2-D morph. "In that scene," said Lo, "the character was pretty much facing forward while pieces of his real identity appeared to come and go. Using Elastic Reality, I could create a single, forward-looking 2-D image, and control how much I wanted it to pop on and off."

Like the earthbound scenes, space sequences in The Fifth Element would entail a marriage of traditional and digital techniques. Among the array of miniatures constructed and filmed motion control were a Mondoshawan spaceship, a Federation warship, a commercial space shuttle, an orbiting cruise ship and a space fighter. Most of the models would be inserted into digitally matte-painted backgrounds that incorporated 2-D and 3-D stars and planets.

The Fifth Element actually opens in space, with CG asteroids racing by as the camera tilts up to reveal a breathtaking view of the Milky Way – a 2-D digital matte painting by visual effects art director Ron Gress. Starting with a NASA photograph that was scanned into the computer and then altered substantially, Gress also rendered a matte painting of the earth for a shot that immediately follows. "I blurred out the photograph to get rid of all the graininess and other imperfections," stated Gress, "then painted the detail back in. Because this particular shot of earth was to be featured prominently in three or four scenes, it had to be unique. We didn't want to use an image that people had probably seen in every coffee table book of earth

photographs. So I removed the tropical part of Africa – the region that is integral to the story – and painted in specific cloud formations that you don't see in a typical NASA photograph."

Subsequent establishing shots of the Egyptian desert locale, where archeologists unearth the Mondoshawan weapon, were filmed on location in Mauritania. Views of the Mondoshawan ship landing were planned through the use of previsualization techniques. "We used Prisms and RenderMan software on an SGI platform to do some very primitive animatics for the opening shots in the desert with the Mondoshawan spacecraft," explained Karen Goulekas. "Luc really loved them because they allowed him to direct our effects work. He would say: 'Make it ten frames faster. Make the ship tilt more.' The animatics were something he could really grasp."

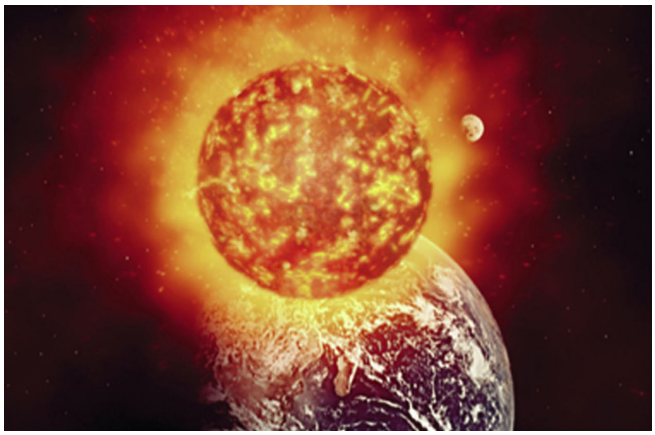
Among the elements composited into the sequence were a 2-D matte painting of the temple and an eight-foot model of the bizarre-looking Mondoshawan spacecraft – fondly dubbed 'the space potato' by the model shop crew. Like all the spaceships created for the film, the Mondoshawan ship was derived from early concept drawings by the preproduction illustration team. Four or five modelmakers, working in clay on a big rotisserie rig, spent a full month sculpting the general shape of the miniature. A hard mold was made from the completed sculpture, and fiberglass copies of individual sections were made. "We assembled those around a steel tube motion control rig armature," commented Niels Nielsen, "and Clark James and his crew threaded a thousand fiber optic points of light to represent the ship's portholes. The tail end of the model was loaded with high-wattage miniature lights to simulate the thrusters. We also added layers of detail across the surface, using all sorts of brass and sculpted skins."

Occupying center stage in Besson's story and seen in some thirty outerspace shots is Evil, the malignant entity from another dimension that threatens the universe with obliteration. Despite numerous preproduction sketches, the design for Evil had proven elusive. Concept art had covered everything from highly mechanical depictions to very organic ones, but still the team had not arrived at a satisfactory look. Evil finally presented itself in the most unlikely of objects. "Mark had a prop he had done on a project called Solar Babies," recalled Ron Gress. "It was a glass globe covered in black, and there were cracks in the surface so that when it was lit from within, they appeared to glow. Luc happened to see it one day, and he exclaimed: 'That's it! That's Evil!' Although it wasn't exactly the look we ended up with, it was a great visual to keep in mind."

As the concept evolved, Evil was envisioned as a rock planet, born in an explosion of light and sound as a red roiling ball of crusted-over lava, moving through stages of development as it rotated in space, expanding in size. Once the conceptual art was approved, Stetson determined that an entirely digital approach was optimal for manifesting the entity in all its phases of expression. "Remo Balcells, and later Tom Lynnes, developed the look of Evil in Alias, which is nice and interactive," stated Karen Goulekas. "But from there we mimicked the same look in RenderMan, because the rendering times are shorter." During months of exploration and discussions with Besson, the digital team came to realize that a more sophisticated effect would be required than had first been envisioned. "Luc really wanted us to be able to control this thing. At one point scientists fire a probe into its surface, and the ball appears to expand. But Luc didn't just want us to scale it up. He wanted the continents on it to overtake themselves, break apart and cover up the lava. You really couldn't do that with a regular procedural shader

in a standard 3-D package. “Then Paul Van Kamp – who came from our software department – said, ‘Well, why not create a fractal program as a 2-D texture map, and wrap it onto a sphere of displaced geometry?’ So that’s what we ended up doing. Not only were the render times really fast, but it gave us complete control. We could regulate the amount of lava, the amount and height of the crust, the speed and activity of the two and the way lava and crust blended together – all through a series of texture maps. Then, if we wanted additional activity, we could go into Elastic Reality and add 2-D morphing or warping to the textures to animate them.”

With ten or more elements comprising every shot of the rock planet, an assembly-line approach became standard practice. “We were using many different software packages,” observed Goulekas, “so no one artist could do it all. It was a real feat for sequence supervisors Chris Roda and Rodney McFall just to keep track of who was doing what.” While some team members were responsible for generating the fractal texture maps and morphing, others were tasked with the placement of the texture maps onto the sphere. Surface details, generated in Alias, added to the digital complexity. “There was an animated layer of greenish, gaseous atmosphere, done as a procedural texture map, floating over the planet. There was a layer of mushroom clouds which burst up from the surface. There was a flame activity layer that was like little torches coming off the surface, plus an active particle layer that emanated from the lava, kind of popping and gaseous.” Final compositing of the individual elements was accomplished in Nuke.



Evil manifests itself as an angry, glowing ball of lava and rock seconds before it is rendered inert by a beam of pure energy emanating from Leeloo and the Mondoshawan stones. The dark entity, in all its phases of expression, was conceived and executed entirely in the digital realm utilizing animated texture maps and 2-D morphing and warping techniques.

With mere seconds to spare before Evil impacts with earth, Korben (Bruce Willis) unlocks one of the stones, releasing its elemental life-force. Swirling pinpoints of colored light floating up from the artifact were computer generated using particle system software.

As Evil makes its final, deadly run toward earth, Korben and Leeloo board a space shuttle bound for the Fhloston Paradise – a cruise-type pleasure craft hovering in orbit above an idyllic water planet – where the Mondoshawan stones have been left for safekeeping. Shots of the cruise ship featured a model built under the leadership of Brad Plows – based on Besson’s prepro-duction designs – floating over a background element of Arete CG water. “Essentially, the Fhloston Paradise was a series of compound curves,” said Nielsen, “almost like a standard tour ship turned upside-down, with the forecastle and various levels of decking stuck on the bottom of the hull.” The model measured about ten feet in length.

“We went for size so we could maximize the detail. It was a big open structure that we loaded with fluorescent lights and lots of smaller lighting units to illuminate the corners. That was sort of an operating principle – keep everything open on the interior so we could really load it up with light. There were lots of windows and glowing ports to maximize the interactive quality of it.”

Trailing Leeloo to the Fhloston Paradise are Zorg, an agent of Evil, and a band of Mangalore mercenaries, who promptly wreak havoc on board. Shots of the vessel breaking in half and exploding, as a Zorg-planted bomb detonates, were achieved with pyrotechnic elements tracked to model photography of the ship. “No models were harmed during the making of this movie,” quipped Stetson. “We accomplished that shot by filming our miniature twice, rotoing it in half and burying the join line inside an exploding fireball effect. The pyro element was shot at night as a zero-G type explosion by a pyrotechnic crew under the supervision of Thaine Morris and Elia Popov.” Following the massive explosion, reverse-angle shots – as Korben, in a hijacked fighter craft, struggles to fly out of harm’s way – also featured pyrotechnic elements. “Those shots were a real challenge to pull off, creatively and technically. Luc’s centered compositions made it difficult to portray the action, and our relatively small-scale fighter model made it hard to get believable interaction from the pyro. We shot wild pyro elements, as large as our conditions permitted; then compositor David Stern did a fabulous job transforming the elements into three beautiful shots.”

For a sequence depicting the panicked vacationers fleeing in lifeboats moments before the Fhloston Paradise destructs, a combination of full-scale sets, miniature set pieces and computer generated boats was used. “That was a very important sequence,” Stetson remarked. “Luc’s goal was to make a PG-13 film. For that reason, he wanted to make it clear to audiences that everybody gets off the ship in time.” A view through the canopy of a lifeboat corridor interior – done as a full-scale set built and shot at Pinewood – reveals digitally rendered boats blasting off from the deck above. “The extension of the hull, seen at the left of the frame, is a miniature set, to which the digital lifeboats were tracked and married. Then, in a wide view from outside of the ship – still intact and orbiting the planet – a swarm of digitally created lifeboats, modeled by Greg Teegarden, can be seen, in two shots, blasting away. Our inspiration for those was the image of an old-time ship firing its broadside cannons, one after the other.”

With a prodigious amount of computer time required for The Fifth Element’s effects work, careful allocation of Digital Domain’s resources, by compositing supervisors Jonathan Egstad and Bryan Grill, was essential in completing the massive compositing chore. Some of the work was accomplished through Onyx workstations running Discreet Logic Flame, but the bulk of the job fell to Indigo 2 workstations running a combination of Nuke and Discreet Logic Flint. “Flint is a smaller package that has most of the features of the larger system,” Egstad observed, “but it doesn’t store as much. However, when used in concert with Nuke, our primary compositing package, we had more power than Flame in terms of what we could composite. We could take the basic files generated in Flint – the composition, timings, positionings and initial color corrections – and convert them into our Nuke compositor, which then executed the composites using our entire network of processors. With the number of shots and the time that we had, we would have needed ten Flame systems to do that. Another big advantage of Nuke was that our

compositors could see the entire composite at once, and make adjustments. One of those New York shots might have up to forty elements – cars, backgrounds, smoke – and all of them could be composed simultaneously in Nuke."

As the film approaches its finale, Korben races back to earth, returning Leeloo and the Mondoshawan stones to the Egyptian temple. There he manages to unlock the mystery of the stones, releasing the elements in swirls of tiny light sources. "Some of Luc's original concepts for the stones called for the essence of the elements to be captured within a sort of glassy prism," recalled Stetson, "but that didn't translate well into strong visual imagery. By the time we got down to a representative image of a particular element, there were two things fighting it. One was its size in the composition – which was generally too small. The other was that it needed to be enhanced with some type of effect – but whatever we put over it made the image even less distinctive. So with Luc's guidance, we moved away from that approach toward something simpler." The effect was eventually computer generated, using a particle system in Prisms.

Surrounded and empowered by the four elements, Leeloo's body emits a blinding burst of pure energy – a blend of digital animation and 2-D matte painting – that freezes the onrushing Evil in midcourse, rendering it harmless and ensuring, at least for another 5000 years, the survival of life on earth. Having survived his own trial by fire, Stetson was satisfied that The Fifth Element's visual delights more than succeeded in capturing the spirit of Besson's long-envisioned fantasy. But even more gratifying was the realization that the film – with its heavily art-driven and uniquely stylized aesthetic – was something of a milestone for his newly adopted company. "Not only was The Fifth Element a satisfying debut piece for me personally," Stetson remarked, "it also represented an important piece of work for Digital Domain – mainly because it was so unlike the sort of hyperreality effects films this studio has been known for. With this film, Luc Besson managed to single-handedly expand our opportunities and avenues of expression."

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Production still photography by Jack English. Digital Domain still photography by Virgil Mirano. Special thanks to Bob Hoffman, Amanda Roth, Rebecca Brown and Barbara Lakin.

CLASSIC RESTORATION
THE LOST WORLD - FOUND!

ARTICLE BY Scott MacQueen

In his 1912 novel The Lost World, Sir Arthur Conan Doyle wrote of dinosaurs, long thought to be extinct, discovered alive in a remote corner of the world and brought back to civilization. Life now imitates art as a copy of the 1925 film version of Doyle's book – also long thought to be extinct, but recently discovered in a remote archive in Eastern Europe – allows Willis O'Brien's stop-motion classic to be reconstructed to almost complete length. When the work now underway at George Eastman House in Rochester, New York, is premiered in early August, the only version of The Lost World known to most modern-day viewers will be superseded by an enlarged edition running nearly 110 minutes.

"Restoring The Lost World is a fabulous idea," enthused Ray Harryhausen, whose own career animating the dragons of our dreams – 20 Million Miles to Earth, The Valley of Gwangi, One Million Years B.C. – was launched in 1945 when his mentor, Willis O'Brien, entrusted him with much of the animation on Mighty Joe Young. "The Lost World was one of the first films my parents took me to. I was three or four years old. It lingered in my mind for years. To my knowledge, it's the first time that animated models of prehistoric creatures were the main attraction in a feature motion picture. It was O'Brien's vision, even before King Kong, that an animated character could be the real star of a film. I think it's outstanding that Eastman House is undertaking the restoration and making the effort to track down the European print. I can't wait to see it again."

After a successful worldwide release – at a running time of about 104 minutes, according to contemporary accounts – the domestic negative of The Lost World was cut from ten reels to five, for 16mm distribution to schools and civic groups via the nascent 'Kodascope Library.' Concurrently, story rights were renegotiated with an eye toward a talking remake, and the foreign negative – made of second camera or alternate takes, thus ensuring original negative quality in foreign release prints – was ordered destroyed. Regardless, time and neglect would doom the nitrate negatives and prints to liquefy, combust or crumble into powder.

For six decades, The Lost World would be seen only in tattered 16mm Kodascope reduction prints or, more often, dupes from them that ran barely an hour. Eastman House obtained the Kodascope five-reel 35mm printing negative in 1948 and generated a 16mm acetate master positive. By the 1970s, only three of the five nitrate negative rolls were still viable when National Endowment for the Arts funding allowed a 35mm acetate fine grain to be made.

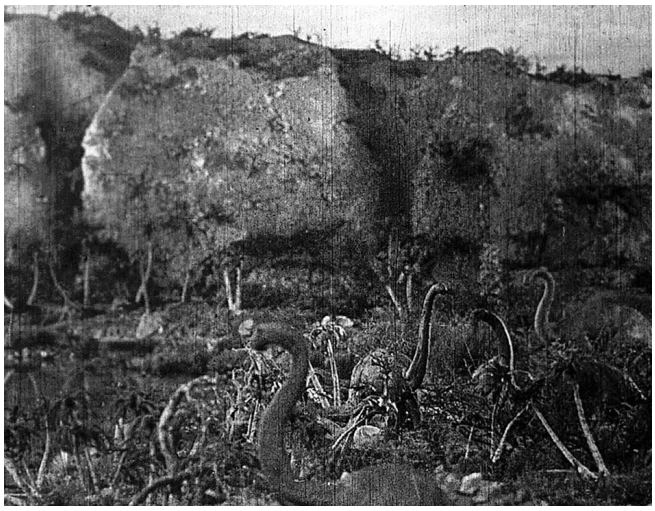
Then, in 1991, Lumivision released a much-lauded laserdisc produced from these high-quality masters. It was still the five-reel version, running 68 minutes at a coherent frame rate of 22 frames per second. But with pictorial clarity, color tinting, and a serviceable musical score, the laserdisc gave viewers the experience of seeing the film as if for the first time. Also included were the original 1925 theatrical trailer and a promotional trailer, which had been preserved by the UCLA Film Archives and the Pacific Film Archives.

It seemed doubtful that the full length version would ever be recovered. Time and resources were running out.

Along with enthusiastic response to the laser disc, however, came news of additional Lost World footage. The most intriguing report was from Pierce Rafferty, co-owner of Petrified Films, who revealed the existence of a nitrate reel of animation outtakes held by his stock footage company. Private dona tions allowed a preservation negative of the reel to be made and deposited with George Eastman House. From the Library of Congress came word of 150 feet of 35mm nitrate print fragments, color-tinted and including several unique shots.

For nearly seventy years, the only surviving version of the original The Lost World has been a half-length abridgement. Now, with the uncovering of a vintage print in the Czech Republic, the silent classic is being restored, almost to full length, by George Eastman House.

Meantime, Eastman House senior curator Jan-Christopher Horak, inspired by the video restoration, determined to mount a 35mm film restoration, and began global inquiries for additional sources that might augment Eastman House's holdings. In 1992, he received positive word from Czechoslovakia that another copy of The Lost World was in the possession of their national film archive. Following Horak's departure for a new position at the Munich Filmmuseum, his successor at Eastman House, Paolo Cherchi Usai, completed negotiations for master material from Filmovy Archiv.



Included in the restored footage is stop-motion animation by Willis O'Brien, including numerous scenes on the prehistoric plateau.

Geography and film distribution patterns have made the Czech Republic the last, best hope for vintage motion pictures that have disappeared in the west. Before World War II, Prague had been the final stop for film distribution in Eastern Europe. There, well-worn prints were abandoned rather than shipped back to a distribution hub. Many of those prints found their way to the Filmovy Archiv, which in recent years has proved to be a treasure trove of vanished American cinema, ranging from John Ford's first feature, Straight Shooting, to Charlie Chan in Paris to the Technicolor sequences from the silent Ben-Hur.

To create an integral 35mm black-and-white preservation negative for The Lost World, work is currently underway at the Haghefilm laboratory in the Netherlands. Under Cherchi Usai's direction, the film will return in a color-tinted 35mm print.

All of this costs money. Since The Lost World is out of copyright, it has no corporate owner to safe guard its existence, and so slips into the twilight zone of orphan films that are doomed to extinction unless patrons can be found to subsidize their up keep. Happily, major funding to restore The Lost World has been provided by Playboy magnate Hugh Hefner, a lifelong mystery and fantasy film buff, whose passion for the Conan Doyle legacy is already allowing the UCLA Film Archives to avert the imminent loss of twelve Basil Rathbone Sherlock Holmes films whose corporate owner has abandoned their decaying 35mm negatives. Further aid for Doyle's dinosaurs is being sought by Dinosaur Interplanetary Gazette editor Ed Summer via an Internet web site

[www.users.interport.net/~dinosaur] devised to solicit additional completion funds.

Without a final shot list or written continuity of the film to provide definitive guidance, Eastman House archivists are reassembling The Lost World from the interior logic of the film fragments and the evidence of the scenario. "We have no way to be certain, shot by shot, what the original U.S. version was," noted Eastman House preservation officer Ed Stratmann, "but we are determined to make the fullest and most watchable version from the available resources." Included in the reconstruction will be nearly 800 feet of animation outtakes – from the Petrified Films find – that appear in neither the domestic nor the Prague material. "The quality of the animation is so high and the sequences are so good that they deserve to be seen, even if we can't be certain that all of the shots were included in 1925." The outtakes – spoiled by minor negative fogging or an animator caught by the camera for a frame – include scenes of a brontosaurus family eating and bickering by a lake, the allosaurus engaging and killing a stegosaurus, the triceratops family sensing the approaching allosaurus, and intimate shots of the pteranodon battling the allosaurus. In all, the outtakes represent eight minutes of prime Willis O'Brien animation that has never been seen.

The original Czech nitrate release print, made from the foreign camera negative, has since decomposed, but the preservation copy negative made from it by Filmovy Archiv – unfortunately without scratch-reducing liquid gate technology – will be used by Eastman House to create new master ma terial of The Lost World's lost sequences.

In 1925, the foreign negative sired dozens, if not hundreds, of prints for all of Europe and Asia. It was already well-worn by the time the Czech print was struck, with negative scratches and repairs printed in. (Fresh intertitles were cut into the prints locally and do not display the same heavy negative wear.) The nitrate print itself was well used, with heavy 'rain' scratch patterns and missing footage at the beginning and ends of all reels.

Local censors also excised the fiercest monster scenes and nearly all allusions to death, so that some sequences familiar to viewers of the Kodascope abridgment are conspicuously edited out of the European print. Fortunately, the Czech copy complements the truncated Kodascope version in such a way that the two prints essentially interleave. Ninety-five percent of the

narrative and ninety percent of the full screen footage should be accounted for in the reconstruction.

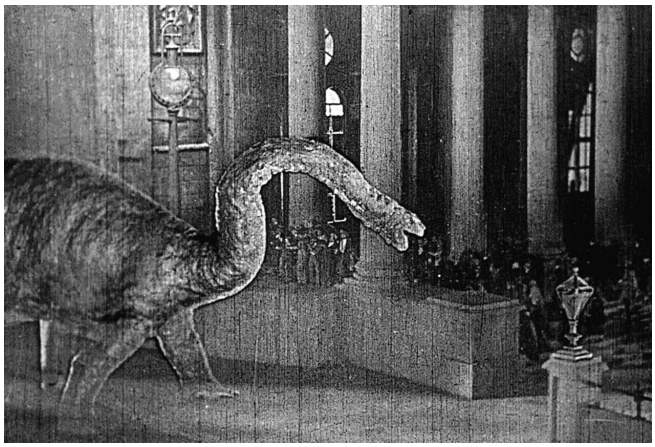
“Where the narrative of the two versions over laps,” commented Ed Stratmann, “the Czech print usually has more angles and longer camera takes, which permits us to restore familiar short scenes to full length.” Often such restorations amplified character motivation as well as storyline. “Even a few frames can dramatically alter the feeling of a scene,” asserted Paolo Cherchi Usai. “Professor Chal lenger and his friends have always seemed a bit blasé when they first encounter the dinosaurs. This was due to how the Kodascope version was shortened. Now we have Wallace Beery’s stupefied reaction at seeing the pteranodon, as well as Lewis Stone’s giddy, disbelieving expression. It makes all the difference.”

While there are exciting new effects and animation unseen in seventy years, the entire movie gains in pacing and structure. With a carefully meas ured first half leading up to the revelation of prehistoric beasts, then piling thrill upon spectacle, the story now unfolds much like King Kong. Little wonder that, in 1932, RKO took the precaution of purchasing The Lost World – assuring it would be Beauty, and not Warner Brothers/First National lawyers, that would kill King Kong.

During the expedition’s journey down the Amazon, four new minutes are spent at the trading post, allowing time for the group to come together and establish their dynamics before plunging into the heart of darkness. Other familiar episodes are substantially lengthened. Professor Challenger’s lecture to a cynical London audience, in which he solicits volunteers to accompany his search for dinosaurs, is doubled in length; and so is his later presentation of proofs to the same audience, as he proudly announces his intent to display his captive brontosaurus. The sequence of the expedition crossing a log bridge to reach the forbidden plateau is longer and more suspenseful, incorporating ex tensive cross-cutting between the bridge, the base camp and the approaching brontosaurus. There is also comic relief of pixilated Professor Summerlee, hovering several hundred feet in the air, becoming distracted in mid-stride by a beetle and nearly plunging off the log.

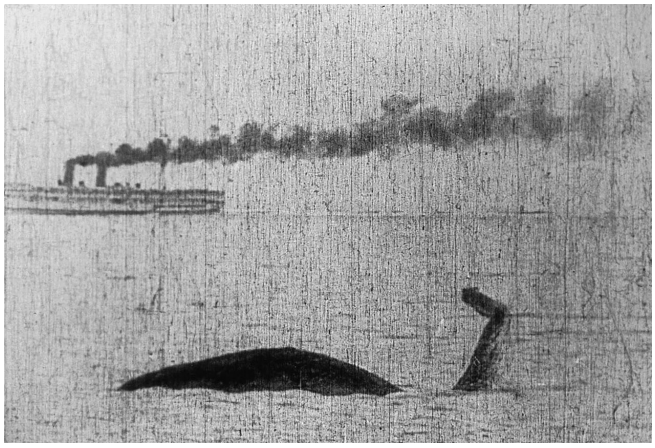
One of the highlights of the standard version has always been the nighttime attack by the allosaurus on the expedition as it camps beneath a ginkgo tree. Now the suspense builds as the predator does not charge immediately, but lies in wait, its glowing eyes blinking in the darkness. Czech censors removed the allosaurus attack – which fortunately survives in the American copy – but the sequel to the event is now recovered. Realizing that the party must find shelter from the beasts around them, Ed Malone climbs the ginkgo tree to scout a safe haven. As he spots the caves beyond the lake – where the second half of the adventure will unfold – he is stalked from branch to branch by a hideous ape man. Sir John Roxton fires at the brute, wounding it in the shoulder, before it leaps to the ground and flees.

The next morning, the expedition party takes up house keeping at the caves. (Day never arrives in the Kodascope version.) New shots depict a brontosaurus herd inhabiting the lake district. Afraid of their friskiness, Challenger decides to create defensive catapults to ward them off. Only the setup for this sequence has been known until now. The scene continues as Challenger and Summerlee argue mathematics: will the released rock describe a curve or a parabola as it soars through the air? Science is answered as Summerlee, arguing from the crotch of a prone liana tree, is pitched into the lake when the restraining ropes break. Startled dinosaurs scuttle off to a safer distance as the pro fessor hurtles past them. “You described a curve!” shouts the triumphant Challenger.



An early traveling matte shot – of the brontosaurus in London – will be on view in the new restoration, which will also incorporate recently discovered animation outtakes.

When Roxton explores the caves, their volcanic nature is clearly in evidence as he passes craters blazing with fire and brimstone. His subsequent discovery of the skeletal remains of Paula White’s father (retained in the Kodascope version) has been removed by the Czech censor. The grim news is here relayed by titles alone. We do, however, see a single backlit closeup of Bessie Love in profile – removed for time in the Kodascope copy – in which Paula prays by candlelight at her father’s grave.



The brontosaurus swims home to South America in a scene long lost from The Lost World.

The group’s escape from the plateau includes more new action and more frequent cutaways to the pathetic brontosaurus trapped in the mud pit. At this point in the story, in what has always seemed a particularly bad bit of writing, Major Hibbard and a ‘geodetic survey team’ gambol out of nowhere to the foot of the plateau and gape at the behemoth. Now the major and his men are established reels earlier, observing the smoke of the awakening volcano, planning to head for the plateau and inves tigate. Their last-minute appearance is no longer a sudden convenience.

The emotional backstory gets a boost, too. With the reinstatement of the framing story, we now learn that reporter Ed Malone undertakes the dangerous adventure as a prenuptial agreement imposed by his feckless fiancee, Gladys. During the expedition, he and Paula White are drawn to each other, but remain chaste. When it appears that they will remain marooned on the plateau for eternity, Paula and Ed surrender to their emotions and plan for Professor Summerlee to marry them. Somehow their rescue alters things, and Paula insists on re leasing Ed from his informal marriage vows. “I can’t steal another woman’s happiness,” she exclaims, sending the

protesting reporter back to Gladys in the real world. Retrieved now is a two-minute scene in which Roxton, having failed to win Paula's affection himself, goes to her like Cyrano to plead on behalf of his young rival.

The real excitement, of course, is provided by the new animation sequences. An erupting volcano ravages the plateau, sending beasts and humans alike running for shelter. This sequence, tradition ally a minute and a half long, now has an additional two and a half minutes of pandemonium. The fire is more thrilling, with the various humans compet ing with the dinosaurs to reach safe ground. Ed flattens himself against a rock cliff to avoid being trampled as the beasts flee past. We observe the animals' pain and confusion as they twist madly, calling each other through the smoke as they seek to escape the fire and lava flows.

Less comprehensive is the footage restored to the London climax. As the frightened brontosaurus tears through the city, there are new first views of it directly outside the lecture hall. (Sadly, the scene of Challenger on the steps, greeting it with smug vindication, is not among them.) The beast snaps and bites at the fleeing lecture patrons. As it makes its way to the stock exchange and topples the statue of Wellington, the behemoth's weight causes its foot to crash through the street. In a shot achieved with an oversized prop, the foot penetrates the ceiling of the underground, squashing a hapless commuter. This stunning image is fragmented – another apparent casualty of the Prague censor's shears. Extended long shots show the brontosaurus pursuing a flock of screaming people. Included are the mother and child who fall in its path in the domestic version; only now we learn that they narrowly escape being bitten by the beast before they stumble.

In other new footage, a drunk emerges from a pub to stare in disbelief. This is merely the setup for a gag that is not retained. According to original reviews, the lush reenters the pub and returns with a saucer of milk, pursuing the brontosaurus, and calling, "Here kitty, kitty." In 1925, this reportedly got big laughs, demonstrating the early wisdom of director Harry Hoyt who realized, well before Hitchcock and decades before Spielberg, that audiences must be permitted to laugh, in the right place, to release tension.

The rampaging brontosaurus thrusts its head through an upper-story window, scattering startled poker players. This scene is executed with an over sized prop head operated by stagehands. Similar practical effects appear in new variant scenes in which the animal's tail topples pedestrians, one of whom writhes in agony as his back is broken.

As the amazed crowd watches, the dinosaur escapes up the Thames and Ed Malone discovers his Gladys in the mob thronging the embankment. (We have already seen her, with a gentleman companion, in the audience at the lecture!) On her arm is her effete, dandified husband, Percy Bumberry, a ribbon counter clerk by profession. "I'm sorry, Ed," whines the impatient virgin, "I couldn't wait!" Of course, in mere nanoseconds, Ed and Paula are playing patty-cake in a taxicab.

Correctly, the Czech material contains no footage of the expedition members being attacked by cannibals, or left to die when their native bearers mutiny. Since still photographs of these sequences were included in the supplemental section of the 1991 laserdisc, inattentive plagiarists, failing to carefully read the sources from which they crib, have rushed into print

describing these sequences as part of the lost original version. Though prepared, at no time was this footage exhibited in The Lost World. In a classic early example of front office insecurity, First National executives had become nervous that O'Brien might fail to deliver his thunder lizards, and produced alternate 'protection' sequences that would allow the film to become a standard jungle melodrama.

"When I was working for OBie on Mighty Joe Young in 1945," recalled Ray Harryhausen, "he told me with great disgust how the screenwriter, Marion Fairfax, came brazenly up to him during the production of The Lost World, and said: 'Don't worry too much, Mr. O'Brien. I've written the screenplay in such a way that if your dinosaurs aren't very good we can just leave them out.' Imagine the cheek – The Lost World without dinosaurs! Of course, OBie's dinosaurs were not left out – but Miss Fairfax's cannibals were."

One last shot came perilously close to being lost forever. The final reel from Prague is heavily worn and missing substantial footage at the tail; but one brief, new animation shot clung stubbornly to the end of the roll – a final image of the brontosaurus swimming home to South America, craning its neck to look idly at a passing steamship.

A happy ending indeed for The Lost World.

The Lost World frame enlargements courtesy of George Eastman House.